JUN 12 1915
UNIV. OF MICH

SCIENTIFIC AMERICAN

USING THE SEARCHLIGHT TO REPEL A NIGHT ATTACK.

Vol. CXII. No. 24
June 12, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, JUNE 12, 1915

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary; Orson D. Munn, Treasurer; all at 233 Broadway, New York.

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.

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Subscription one year	$3.00
Postage prepaid in United States and possessions, Mexico, Cuba, and Panama.	
Subscriptions for Foreign Countries, one year, postage prepaid.	4.50
Subscriptions for Canada, one year, postage prepaid	3.75

The Scientific American Publications

Scientific American (established 1845) per year	$3.00
Scientific American Supplement (established 1876) " "	5.00
American Homes and Gardens " "	3.00

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Munn & Co., Inc., 233 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Some Thoughts On the War

At a time when the war is assuming more gigantic proportions, it seems almost idle to speak of Peace. Nevertheless, the problem naturally presents itself, how and when could the conclusion of peace be considered as a possibility. One of the most discouraging features of this world war is the fact that when this war broke out the nations of Europe fought, not to adjust or settle any profound principle of right or wrong, not to adjust some grievance, not surely for the love of fighting, but in obedience, it would seem, to some perverse fate. There surely had been no well defined and commonly accepted issue; the reasons given were as varied as the nations engaged. In case some visitor had appeared from a neighboring planet, it would be easy to imagine his utter amazement at the sight of the warring nations killing each other, destroying each other's cities and homes and engaged in mutual murder and devastation; but his astonishment at this would have been nothing as compared with his state of mind when he discovered the inability of the combatants themselves to explain just why they were fighting.

The war broke out suddenly without any preliminaries; there had been no act of aggression, no hard words had passed, and as between most of the warring nations there had been even no diplomatic disagreements. In short, the war came out of a clear sky, without meaning, without principle, with no just cause, and with no wrong to adjust. It is this lack of justifiable cause for war that renders the hope of peace so remote. There is no primary wrong to adjust, there is nothing to arbitrate. So upon what grounds could peace be effected?

The present offers a proper time to consider what the ten months of horror have achieved. The record shows a vast preponderance of advantage in favor of the Teuton Allies. Germany holds the greater part of Belgium, a fair portion of France, a large part of Poland. The Fatherland is thus far intact and may prove to be impregnable. In case, with the increasing strength of the Allies, and in view of the settled policy of Germany, which has been turning the neutrals of all nations into avowed or unavowed hostility, the tide should turn (as it surely must) what can the result be? Will there follow a higher and better order of things? What will the Europe of to-morrow be like? The flower of manhood in Europe is being destroyed by the thousands and tens of thousands, the land is being laid waste, whole peoples are dying of want and hunger, the destruction of material wealth is going on at an unprecedented rate. The national debt of the warring nations is reaching untold sums. The bills must be paid, not only by the present, but by future generations. Will not the burden be too great for the people to bear? The future of Europe seems dark indeed. Although the material destruction that has already taken place is figured coldly in the newspapers in millions and billions of dollars, and has involved the complete wiping out of some of the most beautiful cities of Europe, this may prove to be but the beginning; for there is ever growing evidence that the war is to be a protracted one.

This material loss, enormous and ever increasing, is not the only or even the saddest burden of the war. Equally appalling is the moral cataclysm which has taken place—the loss of faith in human nature, the breakdown in the sacredness of treaties and contracts, the race hatred that has been engendered, the overturning of ideals, and the setback to the advancement of civilization. How changed would be the conditions if the war were being waged for high principles from which some lesson of right or wrong might be learned. It might then be hoped that some basis might be reached for the establishment of a permanent peace. It seems, however, that this cannot now be done except through the sad and awful expedient of the complete exhaustion and subjection of one or the other of the warring nations. Will the nations of the future, the new nations that must be born out of the ashes of the present terrible struggle, hold to a simpler creed and a higher diplomacy, substituting the new diplomacy of truth for that of deception? Will they have higher ideals of human faith and responsibility? Shall we witness the birth of a new era, in which will be found a greater belief in, a higher regard for and a more human sympathy with one's neighbor, even though he be of foreign blood? Perhaps, when the great bitterness of the struggle is over and the waste and futility and sin of it all are understood, some such readjustment of the world's ideals may follow.

When the German Fleet Comes Out

THE forlorn hope has no part in the scheme of German tactics either on sea or land. Even when she has hurled her men in masses against seemingly impregnable positions, we may rest assured that her generals have believed that the chances of success were good. As on the land, so on the sea. We may rest assured that Von Tirpitz will never send out the German main fleet for a trial of strength with the British except under conditions which afford a reasonable promise of success.

As matters stand to-day, the German first fighting line includes probably seventeen dreadnoughts; against this force Great Britain could oppose to-day, including ships commissioned since the war began, thirty-eight dreadnoughts. In point of numbers of ships, this means a superiority of over two to one; but if we take into consideration the heavier batteries and higher speed of the later British ships, the actual fighting superiority is about three to one.

As to the future, it is certain that the longer the war lasts the greater will be the British advantage; for under the accelerated rate of construction, she is adding to her main fleet at the rate of over one dreadnought per month.

Is the German main fleet, then, destined to spend the long years of this war condemned to hopeless inactivity within its own harbors and roadsteads? We doubt it. On the contrary, we believe that, when the readjusted plans of the German Admiralty are ripe for prosecution, the German fleet will issue forth in full force for a great trial of strength along those strategical and tactical lines which, under the present naval conditions in the North Sea, alone can offer her any chance of victory.

The proposed scheme of German naval operations prior to the war was to reduce the British battleship strength by ceaseless destroyer and submarine attacks, and when this process of attrition had reached the desired point to issue forth for a line-of-battle engagement. So far as the German destroyers are concerned, the results have been practically *nil;* the submarine, on the other hand, in the early stages of the war and before the British had learned by experience how to meet this form of attack, scored some very notable successes. For several months, however, at least in the North Sea and around the British Islands, submarine activity against the fighting fleet has produced no recorded results. Failing against their legitimate prey, the German submarines turned savagely upon the unarmed merchantmen of the enemy.

We offer it as a plausible, if not a probable theory, that the German tactics, when the great sea fight comes off, were foreshadowed in the operations of the German battle-cruiser fleet a few months ago in the North Sea. We believe that the raiding of undefended towns on the east coast of England was not so much an exhibition of what has been termed German "frightfulness" as it was the preliminary stage of a German strategy, which was designed to draw the British fleet into action and lead it in a stern chase into waters where flotillas of German submarines awaited its coming. This theory would explain two very remarkable facts which certainly seem to require explanation, connected with that running fight across the North Sea. The first of these was the complete abandonment, by the powerful German armored battle-cruisers, of the unfortunate "Bluecher," whose destruction was certain as soon as they drew away from her. The other, and more astonishing fact, is that after the flagship "Lion" had been put out of action by a shot in her engine room, and the odds, so far as the ships engaged were concerned, were three German to two British ships, the Germans, with an advantage of twenty-eight armor-piercing guns against only sixteen on the two British cruisers, failed to close in and attempt to sink the enemy with an overwhelming superiority of gunfire.

For it should be noted that the 29-knot battle-cruisers, "Doerfflinger," "Seydlitz," and "Moltke," "Princess Royal" and "Tiger," had pulled out far ahead of the slower "Bluecher," "New Zealand," and "Indomitable." When the "Lion" was disabled, therefore, these German battle-cruisers were able to oppose eight 50-caliber 12-inch and twenty 50-caliber 11-inch armor-piercing guns to the sixteen 13.5-inch armor-piercing guns carried by the two British ships. If the Germans had immediately closed in to nine or ten thousand yards, their guns would have been able to penetrate the 9-inch belt armor of the British ships with ease; and with a superiority of twenty-eight guns to sixteen, and anything like equal shooting, the result would have been a foregone conclusion.

Why did not the German admiral seize such a tempting opportunity? Certainly not from fear of the British fire—that has never been a German characteristic. We are inclined to believe that, in continuing his flight, the German admiral was acting under strict orders and according to a predetermined plan, which was to lead the British fleet into waters where a flotilla, or perhaps several flotillas, of German submarines were gathered. That this was the plan is suggested by the fact that the British ships did run up to a group of submarines, and indeed came so near to running through them, that Admiral Beatty from the bridge of the "Princess Royal" saw the streak of an approaching torpedo, and only by a quick turn of the helm avoided it.

It is possible and, to our minds, rather probable, that the German Admiralty, realizing the hopelessness of any attempt to gain equal strength with the British in capital ships, is devoting the whole of the country's shipbuilding strength to the construction of submarines of the greatest size, speed, radius of action, and torpedo-carrying capacity. At the opening of the war, Germany probably did not have over twenty-five submarines in commission. If, early in the war, she ceased the construction of capital ships and devoted her whole energy to the construction of a vast submarine fleet, it is possible that she may have over a hundred of these craft to-day in commission, and this in spite of her many losses. It is conceivable she may have another hundred or even more under construction. Undoubtedly as fast as they are completed and the crews can be found, the new boats are put into commission. It cannot be disputed that the work of hunting down and sinking the merchant ships of the enemy affords the German submarine fleet every opportunity to become proficient in maneuvering and torpedo practice.

Now, if this be the German plan, it can be seen at once that the military value, in the way of training the crews and the shaking down of the submarines into thoroughly serviceable condition, which is involved in this far-flung series of operations directed against merchant ships, is of far more value to Germany than the mere loss by the enemy of 2 or 3 or even 5 per cent of his merchant fleet.

When Germany feels that her submarine fleet is sufficiently numerous and its *personnel* fully efficient for the prosecution of her long-deferred offensive, we may look for a general calling in of the raiders to the home ports, and a sudden cessation of the sinking of merchant ships. Whenever that occurs, it will be reasonable to watch for the exit of the whole German fleet in full strength to seek and get in contact with the enemy. Contact once secured, we may expect a repetition on a grand scale of the tactics employed in the recent battle-cruiser engagement. There will, conceivably, be a pretended flight of the German fleet from superior forces and an attempt to lead Admiral Jellicoe and the fighting forces under his command into a veritable shoal of submarines.

Should the German ruse prove successful, and the British destroyers fail to locate the submarines and give timely warning, it is conceivable that within a short time after it ran into the snare, 50 per cent of the British fleet would be out of action. Admiral Jellicoe and his staff, however, are perfectly familiar with all the possibilities above suggested; and it is conceivable that, in spite of his enormous superiority in strength, he might refuse to follow the German lead.

Some day, and under conditions which suit themselves, the Germans will come out into the North Sea in full strength; and when that happens the world will witness a series of maneuvers and a great battle or series of battles which, in point of interest, novelty of conditions, and frightful destructiveness, will set a new mark in the history of naval warfare.

Science

The Scientific Survey of Porto Rico, under the auspices of the New York Academy of Sciences in collaboration with the American Museum of Natural History and other institutions, is now in its second year. A second annual appropriation of five thousand dollars toward its expenses has been made by the Porto Rican government.

Photographic Measurements of Ocean Waves are to be made by Profs. Penck and Laas with the aid of funds provided by the Berlin Academy of Sciences. More definite information than has heretofore been available regarding the shapes and dimensions of waves is a desideratum felt in ship-building, harbor construction, and coast protection.

An Institution for Ethnological Research modeled largely after the Bureau of American Ethnology in Washington, has recently been founded in Leipzig with the aid of funds furnished in part by the government and in part by Prof. Hans Meyer. According to the description of the new institution published in *Petermann's Mitteilungen*, it represents the realization of a plan proposed years ago by the celebrated traveler and ethnologist Adolph Bastian.

The Most Remarkable Photograph of a Meteor Trail that has yet been taken, so far as we know, is reproduced in *L'Astronomie* for March, 1915. The meteor in question was seen from many points in South Africa about 5 P. M. on June 2, 1912—i. e., in broad daylight—and the trail that it left behind it remained visible until some time after sunset, becoming more and more conspicuous as the daylight faded. The photograph in question, which shows the trail as an immense serpentine ribbon in the western sky, was taken at Tempe, Orange Free State, about an hour after the passage of the meteor. This remarkable meteor is discussed in Circular No. 1 of the Transvaal Observatory.

The Temperature of Pine Needles in Winter.—In the *American Journal of Botany* Mr. John H. Ehlers describes the results of measurements of the internal temperature of pine leaves in winter, obtained by means of ingenious thermo-electric apparatus. He found that these leaves, under winter conditions, maintain temperatures from 2 to 10 degrees (centigrade) higher than the surrounding air, owing to the absorption of radiant energy. The average of 650 readings taken in February between the hours of 8 A. M. and 3 P. M. was a little more than 3 degrees above the air temperature. This difference, says the author, is sufficient to be considered an important factor in photosynthesis.

Lightning Conductor Containing Radium.—Mention is made in a recent number of the German journal *Prometheus* of a lightning-conductor which, it is claimed, gives much more effective protection than the usual rod. The inventor took an ordinary lightning-rod and equipped it below the point with a disk that was overlaid by electrolysis with about 2 millogrammes of bromide of radium, so put on that it was weatherproof. The experiments made showed that the preparation of radium ionized the air, making it conductive, for a wide circuit around the point of the ligthning-rod. This led, naturally, to a decided fall of potential in the atmospheric electricity, and to equalization between the various strata of air lying in layers one over another. The charge of atmospheric electricity in these strata flowed toward the point through the air, which was still a good conductor even at a considerable distance from the point of the conducting-rod, and was carried from the point to the ground. In addition to the increase of radius of action of the lightning-rod, the ionizing of the air by a preparation of radium seems to cause the carrying off of stronger currents of atmospheric electricity.

Electric Wire and Cable Terminology.—No task is more difficult (and few are more important) than that of setting in order the vocabulary which has grown up spontaneously in connection with a rapidly developing art or science. The standardization of electro-technical terms has already made good progress, owing to the efforts of various electrical engineering societies and international commissions. The latest contribution to this task takes the form of a circular of the United States Bureau of Standards on electric wire and cable terminology. Misunderstandings between manufacturers and purchasers of wires and cables have frequently occurred in consequence of the divergent use of terms, and accordingly the standards committee of the American Institute of Electrical Engineers recently gathered information as to existing usage with a view to securing greater uniformity. The results were turned over to the Bureau of Standards, which continued the inquiry and prepared the definitions now published. The Bureau had special difficulty in securing agreement upon the words "strand" and "cable." According to the definitions adopted, a strand is one of the component parts of a stranded conductor, each part being either a single wire or a combination of wires. In the latter case, each wire of the combination is itself a strand of the composite strand, the principal idea in the word "strand" being that it is a component part of a larger unit. Some good pictures help to elucidate the principal terms defined.

Automobile

The Kaiser's Brother a Patentee.—Heinrich Prinz von Preussen of Kiel, Germany, assignor of one half to a Berlin company, has secured patent No. 1,095,468 for an appliance for cleaning windshields on motor vehicles including wipers either on one or both sides of the glass which, by a quick stroke of the driver, may be moved over the glass to remove dust and water.

A Garage in an Office Building.—One of the latest improvements in office buildings, in the thickly populated eastern cities, is the installation of an automobile garage in the basement for tenants who prefer to come to the office in their motor cars. The first of these buildings is now in course of construction at the corner of Van Halst and Hunter's Point Avenues, Long Island City, N. Y., directly opposite the Long Island railroad station, and adjoining the Steinway Tunnel. The garage facilities are to be included in the rent, at a very small increase over the usual rate.

Screwdriver and Hammer.—No instrument in the whole line used by motorists is so frequently misused as the screwdriver. It seems second nature for a mechanic who happens to have one handy, and who needs something to drive a nail, or tack, or to straighten out a bulge, to use the screwdriver as a hammer. This is certainly not good for the handle of the screwdriver. Some bright genius has placed on the market a so-called "hammer-handle" screwdriver, which is exactly what its names indicates. It is both a screwdriver and a hammer, with the added advantage of affording more leverage to the fingers when it is used as a screwdriver.

Automobile Racing at Night.—A test was made at the Indiana State Fair Grounds recently of a system of illumination in order to demonstrate the practicability of automobile racing at night on a mile course. The test proved a complete success. Lights of the type used in contracting and railroad work for emergency operations at night were placed at intervals about the track. Each light was supplied with a cylinder of dissolved acetylene, and developed a light of from twelve to fifteen thousand candlepower. The test demonstrated that this form of illumination makes it as easy to follow the racing at night as in broad daylight.

Assembling American Cars in England.—Realizing that American automobile manufacturers have far outstripped British makers, particularly in the field of the low-priced car, British manufacturers are seriously considering assembling cars in Great Britain from imported American parts, and selling them as British cars. Last year one of the best-known designers of small cars in Great Britain placed a large contract for American gasoline motors and other parts in this country, to be used in a car of the Morris-Oxford type. The export statistics for March show no less than 3,500 of these motors were shipped to great Britain in that one month.

Grooved Concrete Tracks for Trucks.—Heavily loaded motor trucks have shown themselves so destructive of highways that in some of the States laws have been passed forbidding their operation beyond limited speeds and weights. A test is being carried out at present on a long private right of way between Pittsburgh, Kansas, and Fort Scott, Kansas. Trucks and cars desiring to use this road can do so upon paying a small toll. The road is fitted with cement or concrete tracks, 12 inches wide and concaved so that the wheels of an automobile will stay in them. It is a single track line, with switches at certain points, to allow machines to pass each other. If this road is successful it will be extended to Kansas City.

An Auto Club With a "First Aid" Squadron.—A new plan of general assistance has been inaugurated by the St. Louis Automobile Club, which deserves the widest publicity and imitation. This club sends each Sunday, during the summer months, five expert mechanics on motor cycles into the highways and by-ways surrounding the city, within a radius of fifteen miles. Wherever one of these members of the "flying first-aid squadron" finds a car that is stalled or broken down expert assistance is rendered. This service is free to all motorists, whether members of the club or not. It is proposed to extend the service to cover Saturday afternoons and evenings, when thousands of automobiles are seen on the roads around the city.

Tubular Bulb for Car Lamps.—A distinct improvement in the shape of bulbs for electric headlights has just been brought out by a Connecticut firm. The new bulbs are tubular in form, instead of being round, with the result that a much more effective light is produced. When a round bulb is inserted in the base of the headlight, rays from the filament have to pass through two and three thicknesses of the glass, on their way to and from the reflector. The tubular bulb, being but of slightly larger diameter than its base sends the reflected rays straight ahead without any further interference by the bulging bulb in the center. The tubular bulb has another advantage, which may on occasion prove highly important. It can be withdrawn through the rear of the reflector, making it possible to use front lenses which are screwed on tight, instead of being hinged to the lamp.

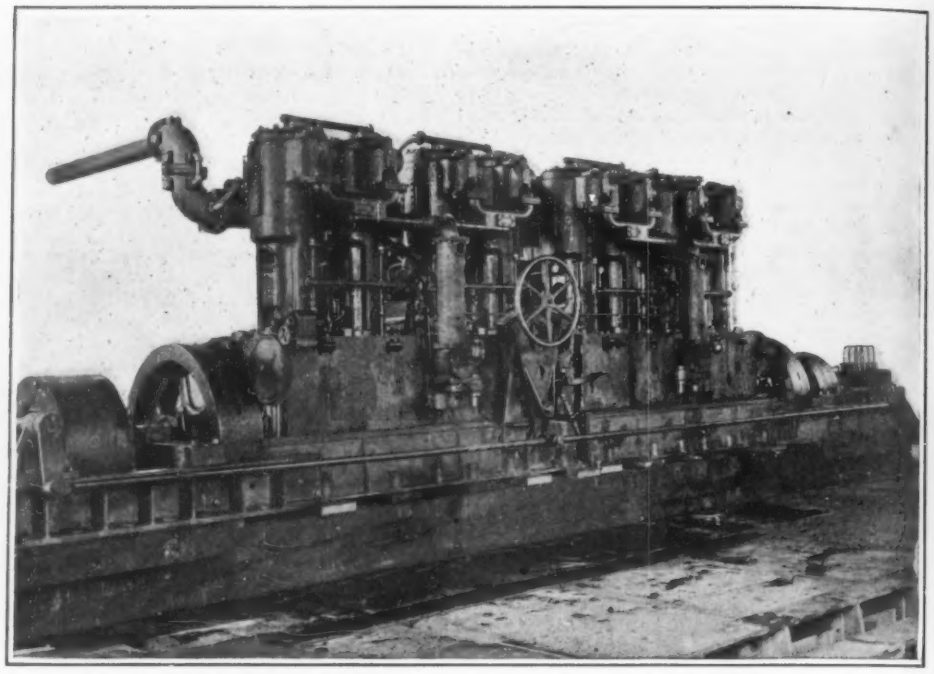
Astronomy

Standard Tests for Small Telescopes.—In a recent number of the *Comptes rendus* M. G. Bigourdan, after reviewing the present heterogeneous and often indefinite methods of testing small telescopes, proposes a testing device suitable for use as a universal standard. This consists of a collection of rectangular diagrams (shown in the article), each of which is a group of straight vertical and parallel lines, spaced at intervals of the same breadth as the lines. The thickness of lines and spaces increases progressively from group to group. A sheet of paper printed with these diagrams is set up at a distance of 10 meters from the telescope. At this distance the width of one line and the adjacent white space in the first group subtends an angle of 10 seconds, and in each of the other groups the width of a similar pair corresponds to a definite angle ranging up to 58 seconds. The values of these angles are shown by large figures. Thus in testing the telescope, the finest group in which the ruling is distinguishable indicates the extreme separating power of the instrument. Various other tests can be carried out; such as comparing the quality of different parts of the objective by the use of suitable diaphragms. While no novel principle is involved in this simple device, its general adoption would make the tests of small optical instruments uniform and definite.

Atmospheric Conditions Favorable for Astronomical Observations.—This important subject is more complicated than is generally supposed, according to Prof. W. W. Campbell, director of Lick Observatory, who goes into the question very thoroughly in the *Publications* of the Astronomical Society of the Pacific. The location of observatories on mountains and plateaus for the sake of securing clear skies and pure air is a comparatively modern development. Great efforts were made to induce James Lick to locate his observatory in the Sierra Nevada Mountains, at an altitude of not less than 10,000 feet, but other and probably wiser counsel persuaded him to select Mount Hamilton (4,200 feet). Some very extensive tests of sites have been made prior to locating observing stations; notably, on behalf of Harvard Observatory, by Bailey and Pickering on the west coast of South America, by Bailey in South Africa, and by Pickering in Mexico, Southern California, Arizona and the West Indies. The tropical island has had several recent advocates, a prominent one being Prof. W. H. Pickering, who has written in the most enthusiastic terms of the "seeing" conditions at Mandeville, Jamaica, at an altitude of 2,100 feet. The best "seeing" at Harvard Observatory ranges from 6.2 to 6.5 on the scale of 10 for perfection, while at Mandeville it is 8.8. The steadiness and definition of stellar images within 30 degrees of the horizon is as good at the latter station as that within 30 degrees of the zenith at the former. For solar observations one of the most favorable locations in the world appears to be the floor of the Kashmir valley, India, at 5,200 feet above sea-level. Several considerations besides actual "seeing" enter into the question of the best location for an observatory. Thus a favorable circumstance at Mount Hamilton is that nights are generally entirely clear or entirely cloudy.

Belgian Astronomers and the War.—The *Gazette astronomique*, published by the Society of Astronomy of Antwerp, was obliged to suspend publication after the events of October, 1914. Thanks to the financial aid of English friends, it has been provisionally re-established in England, and the first number under the new conditions (No. 9, 1914) was issued in April of this year. Its continuance will depend upon the amount of support it receives, and it will, in any case, appear at irregular intervals. A considerable part of the contents will be in English. An absorbingly interesting feature of the number just issued is the information given therein concerning the experiences of Belgian astronomers during and after the German invasion, including a graphic account of the occupation of the Royal Observatory, at Uccle, by German meteorologists. On August 20th the observatory—which in ordinary times is the headquarters of the national meteorological service as well as the national astronomical center—was made a "field weather station" of the German army, similar to those established by the Germans at Liége and Namur, and later at points on the Belgian coast. Four German meteorologists, guarded by a company of soldiers, moved in, bag and baggage, and at once began making regular observations, not only of surface conditions, but also of the upper air-currents, with the aid of pilot balloons, including electrically lighted balloons for the night observations. The results were telegraphed to the Deutsche Seewarte at Hamburg. About the middle of November the observatory was made the "field weather center," or headquarters of the whole system of field weather stations maintained by the German forces. Meanwhile several Belgian astronomers, who had remained at the observatory, were allowed to continue their astronomical work, including the service, and this arrangement is still in force. The regular meteorological work of the observatory, on the other hand, which included the publication of the valuable daily weather maps, is discontinued.

One of the big cylinders—bore, 16 inches; stroke, 20 inches.



An eight-cylinder 600 horse-power gasoline engine; weight. 120,000 pounds.

Largest Commercial Gasoline Engine Ever Built

IN view of the recent developments of the gasoline engine in eight-cylinder units, unusual interest attaches to an engine which has just been completed on the Pacific coast. Although designed for marine work, it shows to a remarkable degree the influence of automobile practice in its general appearance. With a total weight of approximately 120,000 pounds, it is unquestionably the largest commercial gasoline engine ever constructed, and its operation is being watched with considerable interest by automobile as well as marine engineers. In these days of Diesel and semi-Diesel engines it is noteworthy that an engine of the electric ignition type should be built in so large a unit, for although higher-powered gasoline engines for racing purposes are not uncommon, heavy, slow-speed engines for commercial service have rarely been built in sizes over 250 horse-power. This 600 horse-power unit is the climax of a gradual development of the heavy gasoline engine which has taken place on the Pacific coast.

The engine measures 46 feet over the thrust bearings and, as previously stated, weighs about 60 tons. As shown in the photograph, the eight cylinders are cast separately and are mounted in line on a plate which is supported from the bed by vertical columns. The cylinders are exceptionally long, measuring nearly six feet. The lower half of each is cut away on two sides to form cross-head guides. It has a bore of 16 inches and a 20-inch stroke. Each cylinder casting weighs 1,700 pounds.

The valves are disposed on either side of the cylinder forming the familiar "T" head and are operated from separate cam shafts under the cylinder plate. Fuel is supplied to the engine through two carbureters in conjunction with two heated intake manifolds, the latter being so constructed that they are heated by the exhaust of the engine. It is claimed that this prevents condensation of the mixture between the carbureter and cylinder and gives a very flexible engine. When running light the speed may be reduced to 38 or 40 revolutions per minute. The normal speed of the engine is 225 revolutions per minute.

This machine has been installed in a double-ended ferryboat utilized for the transportation of trains across an arm of San Francisco Bay. This vessel is 236 feet long and 58 feet wide, carrying three tracks on the main deck. The engine is set in the center of the vessel and is connected through clutches to propellers on either end.

Notwithstanding the high cost of fuel for operating an engine of this size, a considerable saving over steam has been effected, by reason of the intermittent service. The trips made are not long, and between runs the engine is of course stopped, thus eliminating all fuel expense while the boat is not in actual use. Starting is accomplished by means of compressed air.

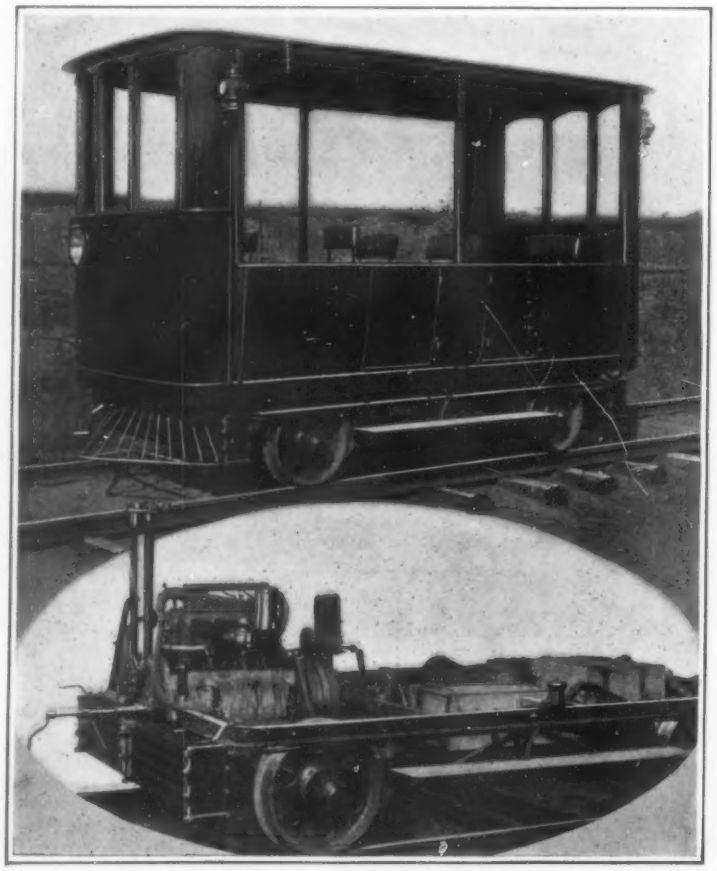
Inspecting Steam Railroads With a Gasoline Car

THE automobile has very nearly supplanted the horse-drawn vehicle, the jitney-bus is becoming a formidable rival of the street car, and now even the steam railroad is being invaded by the motor vehicle. The accompanying photographs illustrate a new motor-driven car adapted for railroad inspection.

The handling of the car is exactly like that of an automobile. It is capable of all speeds from four miles to fifty miles an hour. In general construction, appearance and finish it is strictly a railway car and not an automobile, although in some respects the general design resembles the same. The car is mounted on steel wheels with turned treads and easy spring suspension, which overcomes the fatigue generally resulting from long trips in other cars used for this purpose. There are eight seats, each independent and swiveled so that they can be swung in any direction, facilitating conversation or inspection of the track.

A 30 horse-power motor is used, which drives through a clutch of single plate design and a three-speed transmission to a jack shaft by means of bevel gears. On the jack shaft the drive is by chain to each of the rear wheels. No differential is required in work of this kind, and by means of a double bevel gear arrangement, all speeds can be obtained in either direction, and the car operated equally well either way. The car weighs 4,000 pounds and is 12 feet 8 inches long and 5 feet 8 inches wide when built for standard gage track.

The utility and economy of this type of car can be appreciated when it is considered that such trips are usually made by special train, or at least in a special car attached to a regular train. Under such circumstances the officials are not free to stop at any or all points where they might desire and so are kept from getting into close touch with the different problems on their roads. The No. 35 Motorcar permits them to run between trains and to stop at bridges for inspection or to consult with the section gang, or to talk with the farmer about some stock which he has lost through a broken-down fence. The tendency of the present day on the part of the railroad officials is to get as closely as possible into personal touch with all those who have to do with the road in any way, either as passengers or employees, or as property owners along the way.



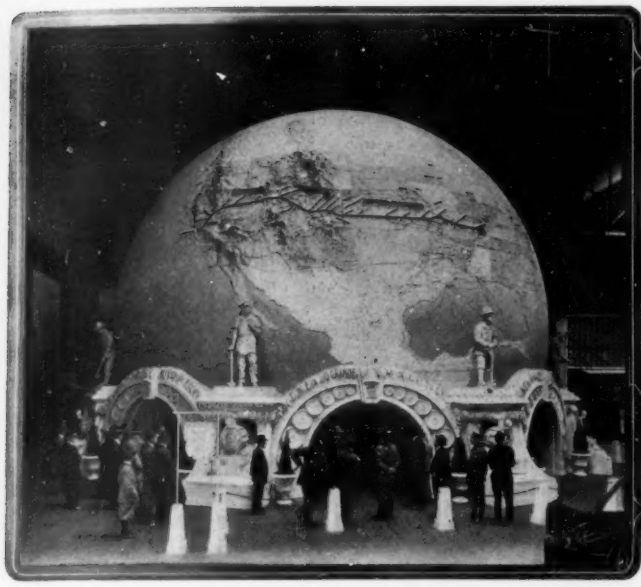
Gasoline-driven railroad inspection car.

Italy and the Copyright Proclamation

FOLLOWING the provision of the Act of Congress of March 4th, 1909, respecting copyrights and satisfactory official assurance having been given that in Italy the law permits to citizens of the United States similar rights to those accorded in Section 1 of the Act of March 4th, 1909, President Wilson by proclamation dated May 1st, 1915, has declared that the subjects of Italy are entitled to all the benefits of Section 1 (e) of the said Act, including "copyright controlling the parts of instruments serving to reproduce mechanically the musical work," in the case of all musical compositions by Italian composers which have been published since May 1st, 1915, and have been duly registered for copyright in the United States.

Sixtieth Exhibition of the Royal Photographic Society

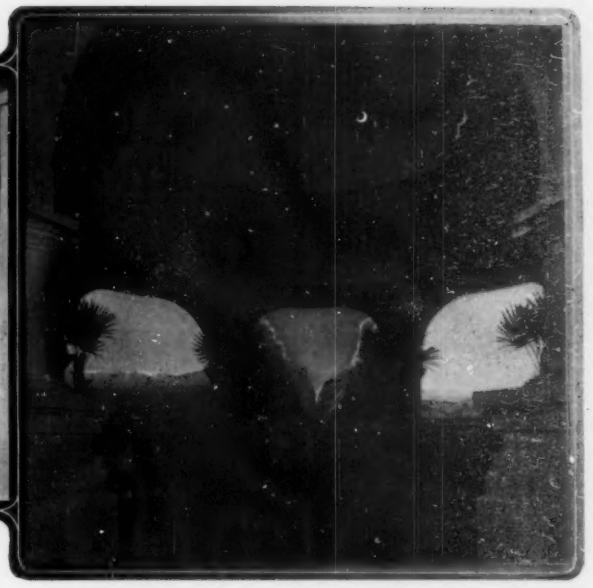
THE sixtieth annual exhibition of the Royal Photographic Society of Great Britain will be held in August and September, next. This is the most representative exhibition in the world, and for a number of years America has taken a most gratifying part in it. Last year the work of American scientific men was conspicuously noticeable, and it is hoped the representation this year can be made fully as excellent. This work should consist of prints showing the use of photography in scientific work, and its application to such branches as spectroscopy, astronomy, radiography, biology and the like. Mr. C. E. K. Mees of Rochester, N. Y., who superintended the collection and forwarding of the American exhibit last year, has again undertaken the work, and asks that contributions be sent to him as early as possible. The photographs should be mounted, but not framed, and should be sent in not later than July 1st.



"The Globe," at the Pan-Pacific Exposition.

Exterior view, showing the trains, composed of electric lights, that leave San Francisco for St. Louis every 20 minutes, and illuminate the names of the principal cities *en route*. Each of the arches contains an illuminated, realistic model of an interesting scene along the line.

Electrical devices under the globe that control the movements of the train, the twinkling of the stars, running water and other startling effects.



Interior of "The Globe," showing three illuminated models of scenes along the route covered by the train of lights.

Note the sky effects in the dome, with realistic moon and stars. These are lighted and the stars are made to twinkle at the will of a concealed operator.

The Largest Spherical Relief Map in the World

TO the thousands who visit the Palace of Transportation at the Panama-Pacific International Exposition a giant globe in the northwest corner of the building is an unfailing source of attraction.

The globe is the exhibit of the Denver & Rio Grande and affiliated railroads.* It is 52 feet in diameter and 44 feet in height. The base, which is cut off, rests upon an imposing pedestal with arched entrances admitting sightseers to the interior of the sphere.

The exterior of the great globe is embellished with a colored topographical map of North America, on which the various routes of the railway system are shown and which presents in detail the various topographical features of the continent.

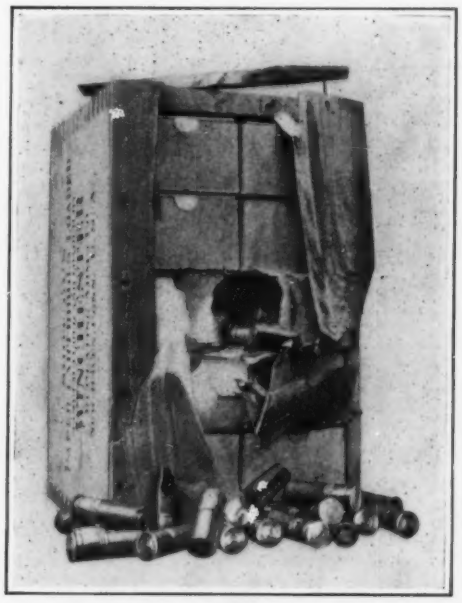
Apart from its size, since perhaps it is the largest spherical relief map in the world, the feature of the exhibit which first attracts the eye is the unique electrical effect which indicates the progress of trains over the routes. The representation is effective. A progressive stream of light indicates that a train is passing through the principal cities and towns along the line, and as each of these is reached the name of the city is flashed electrically, attracting the attention of the spectator to that particular point. Much work was involved in the creation of the electrical effects. For the train effect alone it was necessary to run 1,500 wires from the "track" on which the train is represented as running, to a circular drum in the interior. On the top of the drum is an arm which constantly turns in a circle, making and breaking the contact which produces the train effect. On each complete revolution of the arm a train makes a complete trip from San Francisco to St. Louis. In addition to the illumination of the names of towns, the name of each railroad is flashed in red above its portion of the routes while the train is traversing it and disappears when the next road is reached. The connections are arranged to show a departure from San Francisco every twenty-two minutes, and consequently there are several trains on the line at the same time between the Pacific coast and the Mississippi River.

The interior of the globe is as effective as the exterior. The principal feature of the interior and of an annex to the rear is found in a series of illuminated dioramas with the foreground built to resemble nature. The dioramas, of which there are twenty-four, portray the principal places of interest along the route. A winding causeway permits the visitor to behold upon the right and left the different dioramic scenes in the order in which they are viewed in a journey over the railroad. The attractive features of the cities and the natural show places are depicted; cañons, waterfalls, gorges, far-away mountain vistas are reproduced in scenes partly painted and partly modeled, and under the colored lights, give the effect that one receives when gazing from a mountain top at some distant perspective when a section of the world seems laid out in miniature. A statistician estimates that three million billion feet of scenery is reproduced. Agricultural scenes also are presented and the effects of sunrise and sunsets, storms and night scenes are realistically produced by electricity.

The interior of the dome, which is remarkable for the fact that despite its size it is a section of a perfect sphere, gives an effective illusion representing the heavens at night, with twinkling stars and forms resembling the constellations, which add greatly to the realism of the scene. The stars are operated from an electrical room below by means of a revolving cylinder which by making and breaking the contacts produces the twinkling effects. Although the darkened vault of the interior of the sphere in which the constellations are set is but 45 feet in height, it is difficult indeed for the visitor to approximate the actual distance of the faintly flashing lights and brightly twinkling stars.

* Western Pacific, Denver & Rio Grande, Missouri Pacific and Iron Mountain.

A case of 1,000 0.30 U. S. Army cartridges, smokeless powder, regularly loaded and packed, dropped 25 feet onto an iron floor covered with oak planking, landing on end and corner. Photographed as it lay after the fall. This case was badly broken by the force of the fall, the top being split and one end of the dovetailing started, but none of the cartridges exploded.



A case of 500 "Leader" smokeless powder shells, regularly loaded and packed, shot through with a four-gage shotgun at a distance of 15 feet, the charge being 9 drachms of powder and 2½ ounces of No. 1 shot. The picture shows the end opposite from that which the charge entered. As is seen, the shells in the pathway of the charge are burned and mutilated, but there was no general explosion of the contents of the case, and those not within the range of the charge were uninjured.

Severe tests by shock and fire to prove that small-arms ammunition will not explode.

Safe Transportation of Small-arms Ammunition

WE have shown in a previous issue that a single submarine torpedo because of its enormous charge of explosive was quite sufficient to sink the "Lusitania" in the short period of time which elapsed between the blow of the torpedo and the disappearance of the ship. The German government has suggested that the rapid disappearance of the ship was due, in part at least, to the explosion of the cargo of ammunition which it carried. To a military man, or indeed to anyone with a fair knowledge of explosives, the suggestion is ridiculous; for the ammunition in the hold of the ship consisted of unloaded shells, and of small-arms ammunition packed in cases which cannot be exploded by any known means.

Some years ago the Winchester Repeating Arms Company, in order to prove that small-arms ammunition could be transported with perfect safety, undertook a series of severe tests to show that such ammunition packed in the ordinary cases was incapable of being exploded either by shock or flame; and we publish herewith a series of photographs of the ammunition as it appeared after passing through the test.

Subsequently, Gen. George Uhler, Supervising Inspector General of the Steamboat Inspection Service, Department of Commerce and Labor, authorized Col. B. W. Dunn, Chief Inspector, to carry out at the factory of the Winchester Repeating Arms Company an additional series of tests, more severe than those made by the company itself, with a view to determining the safety or otherwise of the transportation by rail or steamer of small-arms ammunition. The tests were duly made, and in his report to the department Col. Dunn said: "In connection with similar tests made previously, it is believed that these results justify the conclusion that small-arms ammunition, while in transit either by rail or steamship, is not accompanied by the explosive and fire risk that would accompany a shipment of the same amount of explosive material in the kegs, boxes and other shipping containers used for such material. The freedom of small-arms ammunition from these risks is due to the necessary sub-division of this explosive material into the very small, well-protected units furnished by the individual cartridges.

"*It is the opinion of the writer that you would be justified in permitting the shipments of small-arms ammunition on passenger-carrying steamers, and that it would not even be necessary on these steamers to require ammunition of this kind to be loaded in the magazines provided for gunpowder and other explosives.*" (The italics are ours.)

Smokeless powder of the kind carried by the "Lusitania" is slow-burning. If a stick of it be held at one end and the other end be lighted with a match, the powder will burn slowly and without any explosive effect. Smokeless power of the nitrocellulose variety is simply colloided guncotton, and the colloiding has the effect of making it slow-burning. The wave of explosion of guncotton, nitroglycerine, or any other of the high explosives, is instantaneous throughout the whole mass; that is to say, the whole of the energy of the explosive is developed instantaneously, and hence its enormous disrupting effect. It is impossible, however, to detonate any of the smokeless powders. The rate of combustion

of such powders can be accelerated by burning them in a closed chamber and permitting the pressure of the gases of combustion to accumulate, which is exactly what occurs in the modern smokeless-powder rifle, in which the rate of burning is so determined that the last grain of the powder will be consumed and converted into gas at about the time that the projectile leaves the muzzle of the gun.

The nearest approach to an explosion of a large quantity of smokeless powder aboard ship would be the ignition of a magazine full of such powder. The increase of pressure, due to the confined gases, would increase the rapidity of the burning, and a degree of pressure would soon be reached at which the magazine would be torn open and the ship more or less wrecked.

In the case of small-arms ammunition, however, where the powder is separated into the small quantity contained in each cartridge, there is no possibility of such a burning in mass. This was proved in the experiments carried on by the Winchester Arms Company and subsequently repeated by Col. Dunn in tests of even greater severity.

In the company's test the cases of cartridges containing smokeless powder were dropped 25 feet onto an iron floor; and in the case of the test made by Col. Dunn for the Steamboat Inspection Service, the boxes were subjected to a fall of 50 feet. The particulars of the company's test are given beneath the respective photographs. In the shooting test made by Col. Dunn a case of 12-gage Repeater loaded paper shot shells, loaded with 24 grains of Infallible smokeless powder, were packed in a case, the cartridges horizontal and perpendicular to the path of the bullets. Three shots were fired. After the first and second shots, no smoke issued from the box, and apparently there was no ignition. The third shot was followed by a slight amount of smoke issuing from the bullet hole, and in a short time smoke issued from the top of the box. Only two of the cartridges were ignited.

In the Government burning test, Repeater smokeless powder loaded paper shells and Nubiack black powder loaded paper shells were placed on an iron grating and a pile of wood saturated with kerosene was placed beneath the grating and set afire. In twelve minutes' time there was a popping of the cartridges, which exploded individually with a firecracker effect. Col. Dunn's report states, "There was nothing approaching a powder explosion. . . . The test indicates that larger quantities of the same kind of ammunition might be burned without causing any destructive explosion." As a result of Col. Dunn's report, the Supervising Inspector General issued the following circular letter to the United States supervising and local inspectors, the chief officers of customs and others concerned:

"The tests of the handling of small-arms ammunition and the rough usage to which it may be subjected without risk of danger from fire or explosion, having been witnessed by representatives of this department, you are advised that the results of these tests justify, beyond doubt, the conclusion that small-arms ammunition may be transported without restriction on steamers carrying passengers, and that it need not be confined to the magazine of the vessel as heretofore required."

Strategic Moves of the War

By Our Military Expert

ITALY'S entrance into the war overshadows all other recent events and speculation is plentiful as to the effect this will have, not only on the developments of the immediate future, but also on the final outcome of the war. Another arc has been added to the ring of fire gradually closing about the Germans, and if the Balkan States should now see fit to follow the example of Italy, the circle would be nearly complete. If the Germans had only to consider the measures they must take to meet this new horde, so suddenly thrown into the fray against them, they would have problem enough to occupy them indefinitely; but they must also make arrangements for the immediate replacement of the supplies of all kinds they have been receiving from and through Italy. This door is now closed to them, and with a formidable enemy to face, their supply of war materials must be appreciably increased at the same time that one of their sources of supply is cut off. A heart stouter than that of a German might quail before such an enormous task.

The Germans probably were not surprised by this decision of Italy, and no doubt they have made such preparations as they could, during the closing period of the negotiations at Rome, to meet the advance of the Italian army should war be Italy's final decision. To what extent they have been able to do this the events of the next few weeks will show. German system and organization, not only in military but in civil affairs as well, are admittedly perfect and capable of accomplishing marvels in great emergencies; but there must be a limit beyond which they cannot go. Is the advent of Italy to be the additional burden that will start the Teuton giant to tottering and finally bring about his fall?

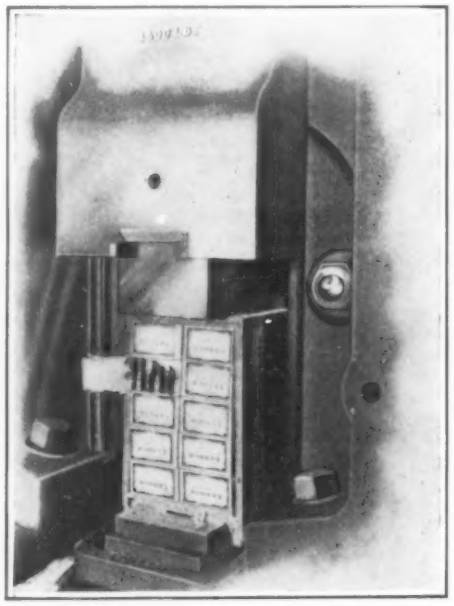
There had not been a time since the opening weeks of the war when the Teutons' star stood as high as just before Italy's declaration of war on Austria. While holding the Allies with fair success on the western front in France and Belgium, with some probability of the same conditions of stalemate being developed along the Dardanelles, they were carrying everything before them in their spectacular and wonderfully successful drive against the Russians in Galicia. This probably will rank as the greatest battle of the war to date, as measured by the number of men engaged and the results obtained. We may or may not believe the reports that have reached us of hundreds of thousands of Russian prisoners taken, and we may be certain that the German losses have been tremendous. In war these things are to be accepted as incidents, more or less trivial. To quote Napoleon, "An omelette cannot be made without breaking the eggs." The German omelettes may have been expensive; but that fact can be forgotten if they are eaten on a victorious battlefield. In war, victories are what count. Grant did not fight his way from Washington to Richmond without losing many men and fighting many battles; but each battle was a victory and left him a step nearer the final overthrow of the Confederacy. To date, the tide of battle in Europe has ebbed and flowed, and the period of the war apparently has not yet come when one side or the other can assume a not-to-be-resisted offensive that accumulates one victory after another and brings about an end of the war.

If Germany and Austria are to profit permanently by the temporary advantage gained over the Russians they must follow up their success by further offensive moves in such strength that victories will succeed each other. Even without Italy to be reckoned with this would have been a stupendous task, but it becomes well-nigh impossible in face of the necessity of putting a powerful and well-equipped army on the Italian frontier. Neither Russians nor Teutons have been able to advance far into the territory of the other. When they cross the hostile frontier they find the railroads less to their liking; supplies, ammunition and reinforcements cannot be brought to the front and wounded cannot be sent to the rear with as much speed as when on friendly soil. Lines of communication are longer and in greater danger, and undefended flanks of the army are left hanging in the air, inviting attack. Germany, some months ago, was able to advance victoriously on Warsaw, until inadequate railroads in Poland and an over-extended fighting line gave Russia, with increased railroad facilities, the advantage she needed to drive the invader back. Russia recently fought her way to the crest of the Carpathian Mountains and paused to gather her strength for a further advance; but this was a slow process, and before it was completed the Germans and Austrians, taking advantage of the admirable system of railroads within their own borders, were able to concentrate a vast driving force at the exposed portion of the Russian line, and proceeded to march through Galicia, rolling up a part of the Russian army and compelling the abandonment of the Carpathian position.

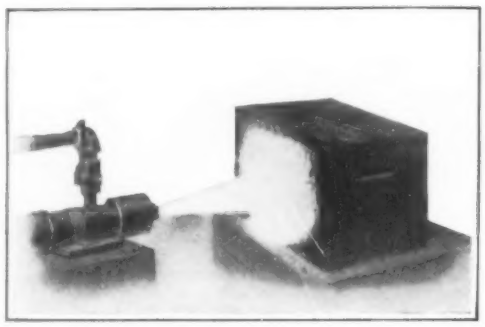
Now the Germans, in their turn, are confronted by the same danger. Again success may be but the prelude to defeat. The force of the German blow appears to be about spent. Before the blow can be repeated new energy must be accumulated through the acquisition of reinforcements and large quantities of supplies and ammunition. Russia should be the first to recover. Any day we may hear of the advance of new Russian forces from the north against what appears to be the exposed portion of the German line. In no previous campaign have the Teutons had so large a stake to play for, and success in other theaters probably will be regarded by them as of minor importance so long as there is doubt of their ability to hold the territory they have wrested from Russia.

The east is likely to continue to be the main theater of the war for some time to come. Viewed very broadly, there have been two main phases of the war to date. It seems to be well established that the plan of the Germans at the outset was to crush France before the more slowly moving Russia could mobilize her masses. They failed to do this. In the meantime the menace of the advancing Russians increased until, because of this and other important conditions, the east became the main field of operations. If the Germans are to win, their superior leadership is the main factor they possess with which to more than offset the superior numbers and other advantages of the Allies. So important did they deem this in the opening of the war, that they did not hesitate to go to the extreme of violating the neutrality of Belgium in order to get the room necessary for the employment of their armies in a way that would make that leadership effective. When the western line became continuous, from the sea to Switzerland, and warfare there was reduced to siege operations, the opportunity for full exercise of superior leadership disappeared. In the east conditions are different. The distances are so great as to furnish ample room for strategic combinations of vast numbers of men, and their employment in accordance with the principles evolved by the German General Staff. The Germans claim to be superior in this class of leadership and point to the victories of Von Moltke, their great leader in two wars, to substantiate their claims.

The advent of Italy may compel the Germans so to weaken their offensive in the east that Russia may not only recover the lost ground, but also continue her victorious advance through the Carpathians and on to Vienna; and the history of the war may record that Italy entered the contest at a critical moment and turned the tide for the Allies. And it may also record that the German allies played a desperate game, allowed Italy to overrun a portion of Austria opposed only by weak forces, further weakened their armies opposed to the French and English in the west, and continued their violent offensive campaign against



A case of 500 "Leader" smokeless powder shells, regularly loaded and packed, struck a blow by a 1,500-pound drop hammer allowed to fall two feet. The entire column of shells was crowded together about 2⅝ inches, shortening each shell nearly half an inch. As is seen, the anvil was forced up through one end of the case, the top and bottom split off, and the shells compressed, but none of them exploded. This is the severest of severe tests of the effect of general shock to a case of shells or ammunition.



A case of 500 "Repeater" smokeless powder shells, regularly loaded and packed, subjected to fire and heat from a gas blowpipe. As is shown in the picture, the side of the case is burned through and badly charred. The expert conducting the test stood close enough to the burning case to rest his hand upon it.

This picture shows the case after the flame was turned off. When the blowpipe was turned off, the fire in the case went out after a little, illustrating that ammunition will not continue to burn by itself. As is shown by the appearance of the case and contents, there was no general explosion of the shells, the case remaining intact, except that part of it destroyed by the flame.

Severe tests by shock and fire to prove that small-arms ammunition will not explode.

Russia with every available man and gun.

Another three months should show whether the entrance of Italy is to have a decisive effect on the final outcome, or whether the German allies will be able to put forth the almost superhuman effort necessary to restore the balance to somewhere near what it was before Italy declared war.

Since the above was written, the great Teutonic drive through Galicia has culminated in the recapture, on June 3rd, of the great Galician fortress of Przemysl. So far as the evidence can be gathered, the victory was due to the preponderance of guns and ammunition possessed by the victorious Austro-German forces. The Petrograd official report of the capture of Przemysl definitely states that the Russian forces suffered from lack of ammunition; and, in the absence of any contradictory evidence, this must be accepted as the truth. How far into Galicia the Teutonic army can continue its advance, unchecked, is a matter of pure conjecture. There is no evidence that Russia lacks in men, and if she can rush the needed supplies of material to the front, she may succeed in stemming the tide of invasion somewhere between Przemysl and Lemberg. In any case this great victory is bound to have a profound effect upon the whole situation; and if the Germans should be content to dig themselves in and hold the Russian lines on the present front, it is conceivable that they may be able to detach considerable forces to meet the crisis which has been developed by the entrance of Italy into the war.

The Germ of Typhus Fever

TYPHUS fever has since the Peloponnesian war at least, been traveling companion to Mars; and its various names—famine, siege, camp, putrid fever—have well indicated the relationship. An adequate history of this infection would be the history of Europe since Charles V, to go no farther back. With its congeners—smallpox, cholera, plague, typhoid—typhus has modified the course of most wars, has indeed abruptly ended some wars. The widespread Napoleonic campaigns served to disseminate typhus throughout Europe; and now, a century after, the like pandemic condition is liable to obtain. And only by the proved ability and vigilance of our coast quarantine authorities are we assured of being spared "visitations" of this pestilence.

This typhus is a filth disease, transmitted by the louse's bite, and only that way. Brill's disease, of which more presently, is a mild form of typhus; and our American tabardillo, which our American physician Ricketts was martyred in studying, is "the thing itself."

The typhus mortality is especially high among military surgeons—it has been 60 per cent; and indeed, up to May 1st last above two hundred doctors and nurses have died in Serbia fighting this so indifferent ally to any and every foe—this slayer of non-combatant and soldiery alike, far more destructive than any ordnance. The only effective means thus far has been to eradicate the louse; which, in the circumstances now obtaining in many parts of Europe, is a procedure as available as was sweeping the Augean stables. So that now, more than ever before in history, is the need of some such prophylactic against typhus as has been so successful against smallpox and typhoid, as has been successful in considerable degree against cholera and the plague. And, indeed, the blessed boon would seem to be forthcoming at this, the psychological moment.

In the pathological laboratory of Mount Sinai Hospital, in New York city, Dr. Harry Plotz, a physician not yet twenty-five years old, isolated from the blood of Brill's disease sufferers a rod-shaped (bacillary vegetable) parasite which Dr. William H. Welch has named the *Bacillus typhii exanthematus*. This germ when first isolated is anaerobic (unable to exist in the presence of oxygen); but after a time it can be grown aerobically (in the presence of air). It is pleomorphic (occurring in various distinct forms), 0.9 to 1.93 microns long and in breadth one fifth to three fifths its length. It is not acid-fast, it has no capsule, and polar bodies can be demonstrated in it. At the time of this discovery the Balkan war was sending over plenty of "straight typhus material"; and Dr. O'Connell, the physician at the Port of New York, allowed Dr. Plotz to take blood from such patients; and these specimens yielded the bacillus got from the Brill's disease sufferers.

Complement fixation tests were then made by Dr. Plotz and his colleague, Dr. Peter K. Olitzky. They used the serum of eight cases of typhus fever; and antigens were made up from organisms obtained both from cases of Brill's disease and straight typhus. The antigen made from the Brill's disease bacillus binds the complement in the same manner as the antigen made from the bacillus isolated from the typhus cases. And complement fixation tests were made in thirty-six control cases with absolutely negative results. Inoculations in guinea pigs of a pure culture of the bacillus gave the disease to those animals. And serum from a convalescing typhus patient was proved to have bactericidal properties against the organism obtained from Brill's disease. Thus, the latter is really an endemic form of typhus, the real, the virulent form being manifest in that epidemic now ravaging Serbia.

These findings Dr. Plotz reported in the *Journal of the American Medical Association* of May 16th, 1914, and on the evening of April 14th last, before the Pathological Society of New York and to the applause and most hearty congratulations of many eminent physicians and scientists, Dr. Plotz announced not only the discovery of the germ of typhus, but also that this discovery has resulted in the perfecting of a preventive serum. It is, of course, too early to be certain of its efficacy; however, many physicians going to Serbia to fight typhus have had themselves inoculated with it, thus evincing their faith in it.

The Current Supplement

WHAT new discoveries are possible in the actual state of science, which would be most desirable, are questions that are considered in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2058, for June 12th, 1915, and the opinions of a large number of noted scientists are given. The substitution of electric for steam power on railroads is a subject that is being discussed with increasing frequency, and from the number of new electrifications that are being made there appears no doubt but that this matter is sure to be of more vital importance, and in the not distant future, than possibly over-conservative railroad men have acknowledged. In this issue is an illustrated description of the electrical equipment of a difficult section of the Norfolk & Western road that has just been put into operation, and is successfully handling heavy tonnage on mountain grades and expediting traffic generally. Another finely illustrated article of general interest is the story of the night illumination of the Pan-Pacific Exposition, which is a triumph of the electrical illuminating engineer, and a marvellous demonstration of modern lighting methods. Electrometallurgy gives an interesting summary of electrolytic methods of extracting various metals and of purifying them. The gyroscope has attracted so much attention of late, both on account of its applications to the aeroplane, and its use in directing the deadly under-water torpedo, that many are desirous of learning how it works. Most descriptions of the action of the gyroscope are so technical that they are quite difficult to understand, especially as the action is a subtle one. Prof. Newkirk of the University of Minnesota gives us the best and simplest explanation that has been published, and illustrates it by excellent sketches. Tides in the Earth's Crust is a valuable contribution for the geologist that will be appreciated by students of science. There is an interesting article on the Time System of the United States, as well as a variety of other useful and readable matter.

A Submarine Sunk by a Zeppelin

By C. Dienstbach

THE first pitched battle has recently been fought between ships of the sea and of the air, resulting in the annihilation of a British submarine by a Zeppelin bomb. This fact seems so striking that an attempt to analyze the lesson taught by this experience, isolated as it is, may be worth making. It is well known that British submarines are specially armed with anti-aircraft guns, which disappear in a recess when the vessel dives, but which are of fairly heavy caliber (among their class) and capable of firing at a steep angle.

While the English underwater craft generally have not yet shown much activity very far from repair shops, their employment as anti-aircraft patrols would seem a very fitting task. Their speed is of course hopelessly inferior to a Zeppelin's, but so is that of the fastest cruiser relatively. But, as in the famous story of the race between the hare and the hedgehog, the submarines might suddenly emerge into conspicuousness just at the goal of the race. The Zeppelin must indeed have been caught exactly like the hare, for voluntarily it would hardly have accepted a fight at such tremendous odds. A submarine flotilla's numerous high angle guns are not so very much smaller than those of a battleship, yet the target offered by the single submarine is so hopelessly tiny that the Zeppelin's escape after sinking one of her foes with a bomb appears nothing short of marvelous, if we recall the difficulty of dropping bombs with precision and the accuracy of high angle fire so far experienced. Mere luck must have played the principal part in the encounter. There would remain just this explanation, that the Zeppelin's speed (with the wind) took her extremely quickly into the conical space directly overhead that is not yet swept efficiently by high angle fire, and that the several bombs mentioned in the report were dropped in such quick succession as to offset any miscalculation of speed and height by their "scattering." Nevertheless, if a tiny submarine was squarely hit by a bomb, the same might much more likely happen to a colossal dreadnought (and that bomb may weigh a ton), which is hardly better defended against the air.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Compulsory Licenses and Working Clause

To the Editor of the SCIENTIFIC AMERICAN:

Samuel S. Dale, in his letter published in your issue of April 24th, does little to impair the argument of Commissioner of Patents Ewing against compulsory license and compulsory working of patents.

Mr. Dale adopts a curious course of reasoning:

"The British working clause of 1907," he declares, "caused an immediate development of manufacturing which had previously been conducted in foreign countries." "But this is not the model," Mr. Dale hastens to assure us, "which we ought to follow." "Advocates of a working clause," he declares, "are not urging the adoption of the provisions of the British patent system." What then are they advocating? Mr. Dale replies: "They are advocating the adoption of an effective working clause in the United States law." But what the terms of this shall be, in what way it shall improve upon the British law and specifically just what it is, Mr. Dale does not state.

There is always a sure, quick and infallible test to apply to enthusiasts with legislative proposals; and that is to compel them to phrase in specific language just the law they want. If their ideas have merit, they readily stand the test. If they lack merit, the process of trying to satisfy the test is always educative to the community and sometimes especially educative to the enthusiast. Perhaps, if Mr. Dale will acquaint himself with the literature which has already accumulated upon this subject and read all the hearings which have been held during the past few years by the House Patent Committee, he would see the answer not only to all the questions which he now raises, but to many other questions which much more industrious students of the problem have raised.

Mr. Dale's quotation from the recent speech of the president of the British Board of Trade is strangely misdescribed by Mr. Dale as "showing that the British working clause will work in the future." In fact, the passage quoted is from the statement of the British government regarding its policy in respect of German patents which, like other German property coming within the control of the British authorities upon the outbreak of the war, have been laid hold of by the government to abide the termination of hostilities. Mr. Dale's naïve assumption that what Great Britain is now doing to the property of the enemies with whom she is at war can afford a wholesome precedent for what the United States should do with the property of foreigners with whom we are not at war is, perhaps, the strangest delusion that the whole compulsory license dementia has yet produced.

What relation Mr. Dale bears to the textile industry, for which he presumes to speak, is not disclosed in his letter. To the credit of this industry it should be said that instead of seeking relief in the will-o'-the-wisp of compulsory license or compulsory working of patents, it is concentrating its attention upon tariff protection against "dumping" which is barely alluded to by Mr. Dale as one of the "other factors" involved in this problem. The hearings before the House Patent Committee last winter at which representatives of the textile industries appeared, and the recent report of the Secretary of Commerce on the dyestuff situation, seem to indicate that the more responsible leaders of opinion upon this subject are laboring under no such misconceptions as oppress Mr. Dale. J. N. V.

New York, N. Y.

The Superheated Steam Unit

To the Editor of the SCIENTIFIC AMERICAN:

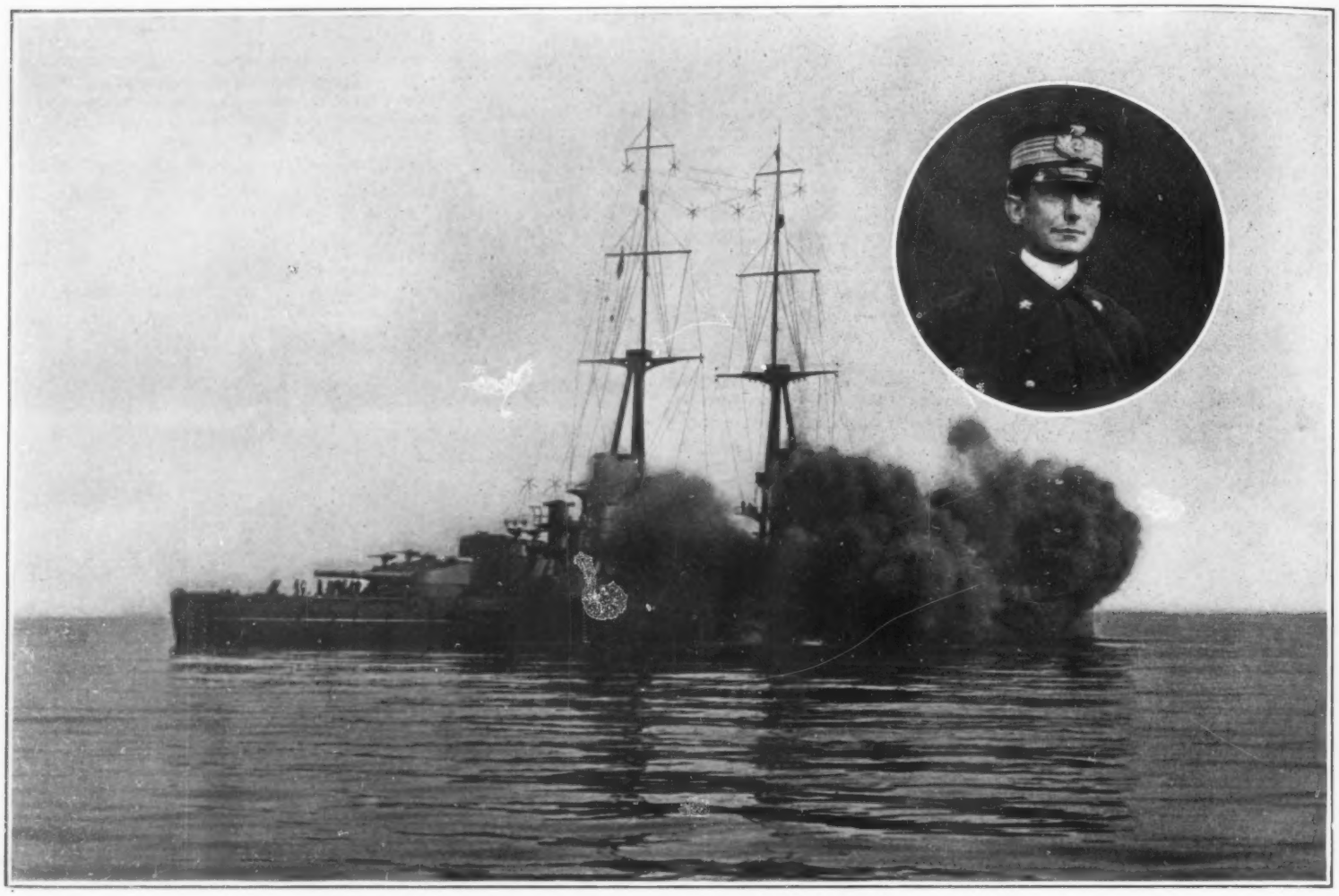
In the issue of March 27th, 1915, of the SCIENTIFIC AMERICAN, I think a mistake has been made on page 290. See third column, test No. 5. The sentence which begins in the twenty-second line from the top is as follows:

"The double superheat feature appears also in this locomobile, and as tested by the exposition judges it gave 8.70 pounds of coal and 1.02 pounds of steam per brake horse-power on a superheat of 649 deg. Fahr."

This statement might be very misleading to the uninitiated. Mr. Miller's article is both interesting and instructive, but it seems certain to me that the words "coal" and "steam" have been transposed. I have accepted the information with this assumption.

Jersey City, N. J. A. L. THURSTON, M.E., E.E.

The "Roosevelt," Peary's Arctic ship, has been acquired by the U. S. Bureau of Fisheries and is to be used in connection with the work of that bureau in Alaskan waters. She was built expressly for Arctic service in 1905.



Duc d'Abruzzi, Commander-in-chief Italian Fleet.

Displacement, 22,000 tons. **Speed,** 23 knots. **Guns:** Thirteen 12-inch, eighteen 4.7-inch. **Belt,** 9¾-inch.
Dreadnought "Guilio Cesare." Five ships in this class.

The Italian Navy

The First Navy to Set Afloat Ships Combining High Speed With Heavy Guns

ALTHOUGH the Italian navy ranks as sixth in power among the leading navies of the world, it is absolutely first class in quality and its *personnel* is believed to be thoroughly efficient. Italian naval constructors have a reputation for originality and skill. Over a quarter of a century ago they launched two remarkable ships which were undoubtedly the forerunners of the modern battle-cruiser. They were known as the "Italia" and "Lepanto." They had the then unprecedented displacement of 14,400 tons and the then unrivaled speed for heavy-gunned ships of over eighteen knots. Each carried four 17-inch 100-ton breech-loading guns, and the bases of the smokestacks and the main battery were protected by armor of from 16 to 19 inches in thickness. A quarter of a century later it was that distinguished Italian naval officer, Cuniberti, who made the earliest, or one of the earliest, plans for a dreadnought battleship of large displacement, carrying an armament exclusively of big guns.

Commencing with the most important class of ships, the dreadnought, we find that Italy completed, in 1912, her first dreadnought, the "Dante Alighieri," a ship of 18,500 tons, designed for a speed of 23 knots, and carrying a main battery of twelve 12-inch 46-caliber guns and a torpedo battery of twenty 4.7-inch. The main battery is mounted in four three-gun turrets, all on the center line. The armor protection in this, as in all Italian dreadnoughts, is rather light, consisting of a 9⅞-inch belt and a 9- to 9½-inch protection for the main batteries.

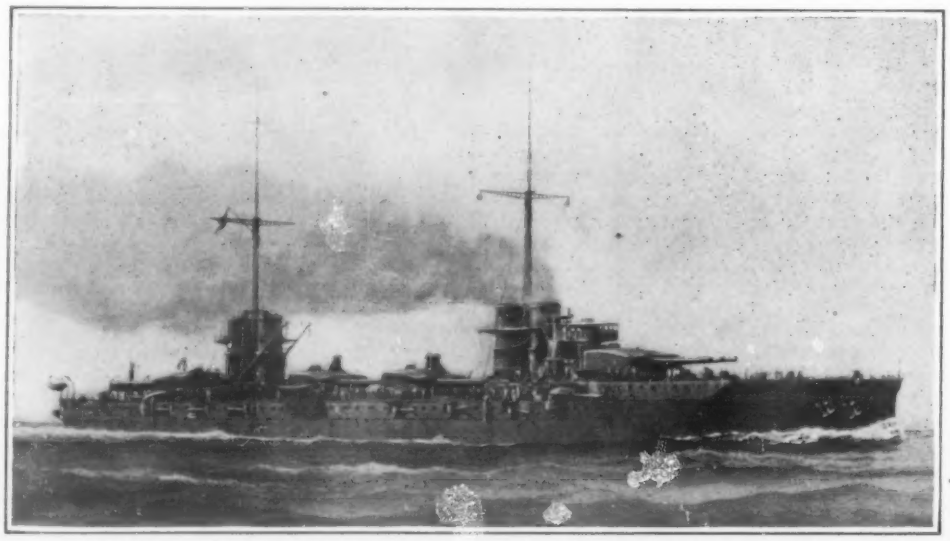
In 1914 the three dreadnoughts, "Conte di Cavour," "Guilio Cesare" and "Leonardo da Vinci," were added to the fleet. These ships, of a speed of 23 knots and of 22,000 tons displacement, are remarkable as being the first dreadnoughts to mount more than a dozen heavy guns, the main armament consisting of thirteen 46-caliber 12-inch guns, all mounted on the center line, as follows: Forward is a three-gun turret, astern of which and firing above its roof is a two-gun turret. Amidships between the two smokestacks is a three-gun turret, and aft are respectively, a two-gun turret and three-gun turret, the former firing above the roof of the latter. The belt and main gun position armor is, respectively, 9¾ inches and 9½ inches in thickness.

Italy is also generally credited with having completed two other ships of this class, the "Caio Duilio" and the "Andrea Doria." If the two last-named ships are completed, and it is probable that they are, Italy possesses a homogeneous squadron of six dreadnoughts, combining great offensive power with high speed. Well handled and properly fought, they should be capable of overwhelming the four Austrian dreadnoughts of the "Viribus Unitis" class.

Italy has laid down and is doubtless now pushing along to completion with all her available forces a class of four 25-knot battleships of the "Queen Elizabeth" class. The first of these, the "Christopher Colombo," gives her name to the class. They are to be of 30,000 tons and 25 knots speed, and the battery will consist of eight 15-inch and sixteen 6-inch guns. Particulars as to the armor protection have not been made public.

The Italian navy differs from any other in respect of its pre-dreadnought battleships; for the limited size, rather light armor protection, and comparatively light gun-fire of these ships would seem to place them more in the class of the armored cruisers than of the pre-dreadnought battleship. Most important of these are the four ships of the "San Giorgio" and "Pisa" classes, vessels of about 10,000 tons and 23 to 24 knots, protected with 8 inches of armor on the belt and main gun positions, and carrying four 10-inch and eight 7.5-inch guns, all mounted in two-gun turrets. These four ships were completed in 1909 and 1910. They could hardly stand up against the three semi-dreadnoughts of the "Ferdinand" class in the Austrian navy, which carry four 12-inch and eight 9.4-inch guns, but they would be a good match for the three ships of the "Karl" class, which mount four 9.4-inch and twelve 7.6-inch guns.

Next in point of age in the Italian navy are the three armored cruisers (or battleships, if you will) of the "Vittorio Emanuele" class of 12,625 tons and 21 knots speed, mounting two 12-inch 40-caliber and twelve 8-inch



Displacement, 18,400 tons. **Speed,** 23 knots. **Guns:** Twelve 12-inch, twenty 4.7-inch. **Belt,** 10-inch.
Dreadnought "Dante Alighieri."

45-caliber guns, the ships being protected by a 10-inch belt, with 8 inches on the main gun positions. These ships were completed in 1907-1908. Preceding these and completed in 1904 were the "Benedetto Brin" and the "Regina Margherita," of 13,500 tons and 20 knots, mounting four 12-inch and eight 8-inch guns, protected by a 6-inch belt and 8 inches on the main gun positions.

In 1901 the Italians built five armored cruisers of a type which found its way into other navies besides their own. They are readily distinguishable by their possession of a single military mast placed amidships and centrally between the two smokestacks. The first of these, the "St. Bon" and the "Filiberto," completed in 1901, are of 9,800 tons and 18 knots, and they mount four 10-inch in turrets, eight 6-inch in a central battery, and eight 4.7-inch behind shields. They are protected by a belt of 9¾-inch nickel steel, with the same thickness on the barbettes. The other three, "Garibaldi," "Varese" and "Francesco Ferruccio," of 7,400 tons, carry one 10-inch and two 8-inch guns, and have 6 inches of armor on the belt and bow decks.

Of older armored ships built between 1887 and 1891, Italy has three battleships of the "Re Umberto" class, of 13,250 tons, mounting four old 13.5-inch, six old-type 6-inch, and sixteen 4.7-inch guns. They are good only for coast defense or the bombardment of coast fortifications, such as is being done by the other armored ships of the Allies at the Dardanelles.

The "Carlo Alberto" and "Vettor Pisani," completed some sixteen years ago, are armored cruisers of 6,500 tons, mounting twelve 6-inch and six 4.7-inch guns. Their present speed is about 18 knots.

Of fast scouts, Italy possesses four of about 3,500 tons and 28 knots speed, carrying a main armament of six 4.7-inch guns. She has eight or ten light cruisers varying in displacement from 2,200 tons to 3,800 tons, and in speed from 18 to 22 knots. Her navy includes also half a dozen gunboats of from 20 to 23 knots speed.

The destroyer fleet of the Italians is first-class in quality and it is believed to be very capably handled. Built and building, it includes about fifty vessels varying in size from 300 to 1,500 tons, and in speed from 28 to 32 knots. The 1,500-ton vessels are under construction, as are also three of 1,000 tons and ten of 770 tons. Of mine layers, Italy possesses three vessels of 850 tons and 20 knots speed.

The Italian submarine fleet includes about a score of vessels completed and, as far as is known, about a dozen under construction. The "Argo" class of about 300 tons displacement are credited with a surface speed of 18 knots and an under-water speed of 14 knots.

The total strength of the Italian navy in officers and men is about 38,000.

Classification of Technical Literature

DELEGATES from about twenty national technical and scientific societies met in the United Engineering Society Building, New York, on May 21st, 1915, to perfect a permanent organization for the purpose of preparing a classification of the literature of applied science which might be accepted and adopted by organizations generally.

There was a generally expressed opinion that such a classification, if properly prepared, might well serve as a basis for the filing of clippings, for cards in a card index, and for printed indexes; and that the publishers of technical periodicals might be induced to print against each important article the symbol of the appropriate class in this system, so that by clipping these articles a file might be easily made which would combine in one system these clippings, together with trade catalogues, maps, drawings, blue prints, photographs, pamphlets and letters classified by the same system.

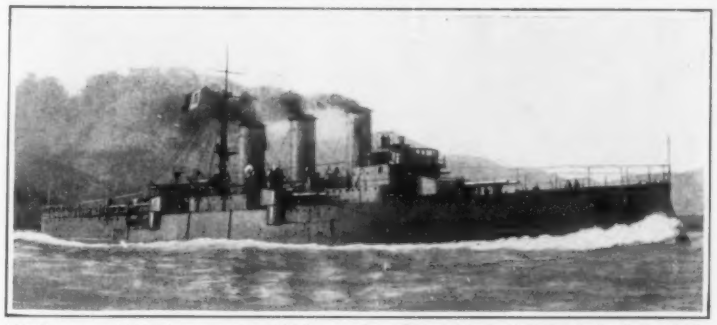
Mr. W. P. Cutter, the librarian of the Engineering Societies' Library, read a paper on "The Classification of Applied Science," in which he stated that no one of the existing classifications was complete and satisfactory enough to be worthy of general adoption. He outlined a plan whereby a central office could collate all the existing classifications, and, with the help of specialists in the various national societies interested, might compile a general system which might meet with general acceptance and adoption.

Permanent organization was effected, and it was agreed that a special invitation to participate by the appointment of a delegate be sent to other national societies which might be interested in the general plan.

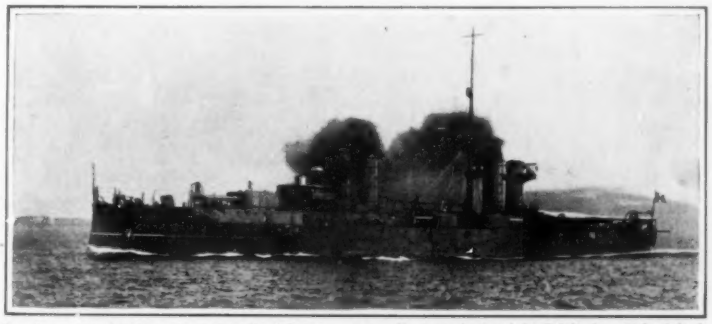
The name adopted for this organization is "Joint Committee on Classification of Technical Literature," and the temporary address of the secretary, Mr. W. P. Cutter, is 29 West Thirty-ninth Street, New York city.

Displacement, 400 tons. **Speed,** 13 surface knots, 9 submerged knots. **Torpedo tubes,** 2.
Submarine "G. Pullino."

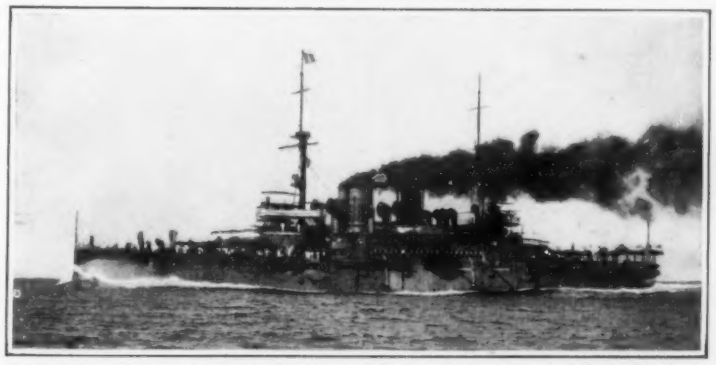
Displacement, 700 tons. **Speed** on trial, 36 knots. **Guns:** One 4.7-inch, four 3-inch. **Torpedo tubes,** 2.
Destroyer "Audace."



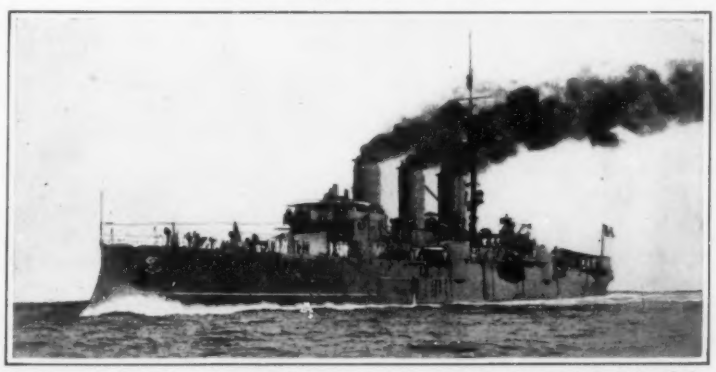
Displacement, 11,000 tons. **Speed,** 22½ knots. **Guns:** Four 10-inch, eight 7.5-inch. **Belt,** 8-inch.
Pre-dreadnought "Pisa."



Displacement, 10,000 tons. **Speed,** 24 knots. **Guns:** Four 10-inch, eight 7.5-inch. **Belt,** 8-inch.
Pre-dreadnought "San Marco."



Displacement, 13,500 tons. **Speed,** 20 knots. **Guns,** Four 12-inch, four 8-inch, twelve 6-inch. **Belt,** 6-inch.
Pre-dreadnought "Benedetto Brin."



Displacement, 11,000 tons. **Speed,** 23½ knots. **Guns:** Four 10 inch, eight 7.5-inch. **Belt,** 8-inch.
Pre-dreadnought "Amalfi."

Prizes for Discoveries Relating to Alcohol

THE Russian Ministry of Finance is offering a series of prizes for inventions relating to the use of alcohol, and covering a varied field of investigation. The various prize offers are as follows: Three prizes of 30,000, 15,000, and 5,000 rubles for a satisfactory method of denaturing alcohol. Three prizes of 60,000, 30,000, and 10,000 rubles for a new product derived from alcohol. Three prizes of 50,000, 20,000, and 5,000 rubles for a new method of applying alcohol to the preparation of a product in which it, or its derivatives, constitute a part. Three prizes of 30,000, 15,000, and 5,000 rubles for new methods for the application of alcohol in an industry in which the spirit, or its derivatives, serve as a transitory dissolving agent, or an extracting or precipitating substance. Four prizes of 75,000, 50,000, 30,000, and 20,000 rubles for an apparatus for utilizing alcohol for feeding internal combustion engines. Four prizes of 75,000, 50,000, 30,000, and 20,000 rubles for improvements in apparatus relating to utilizing alcohol, or its derivatives, as fuel. Four prizes of 50,000, 30,000, 15,000, and 5,000 roubles for apparatus for applying alcohol to lighting purposes. The declarations relating to these competitions must be filed not later than January 1st, 1916, with the Department of Unassessed Taxes and Spirit Monopoly (Glavnoe Oupravlenie Neokladnich Sborow i Casenoï Prodagy Pitel, Petrograd). It may be noted that a ruble is equivalent to about 51 cents of our money.

A New Burglar-proof Safe

A RECENT report from the American Consul at Nuremberg, Germany, announces that the famous Krupp Works at Essen have discovered a burglar-proof safe which will "put all the burglars to shame." The discovery consists in the production of a steel which will withstand the attacks of the oxyacetylene flame, and that it will be impossible to burn a hole through the safe with the acetylene flame either in the time at his disposal or the amount of acetylene and oxygen which the burglar could carry to his base of operations.

At a melting test it required one and one quarter hours of burning and used up 176 gallons of acetylene and 534 gallons of oxygen to burn a hole 1 9/10 inches in diameter and 1 4/10 inches deep into the plate. Such an operation did not burn an opening which would allow the hand to be inserted.

In order to produce a hole large enough to admit the hand, the operation requires six hours of time and 2,400 gallons of acetylene and 2,600 gallons of oxygen. This would require 600 pounds of raw material for the burglar's operation besides requiring almost the whole night to burn through a plate 2 inches thick.

The steel from which the safe is constructed is so hard that it cannot be bored and tapped and all screws and rivets must be made and cast with the plates.

The Westinghouse Electro-pneumatic Air Brake on the Pennsylvania Railroad

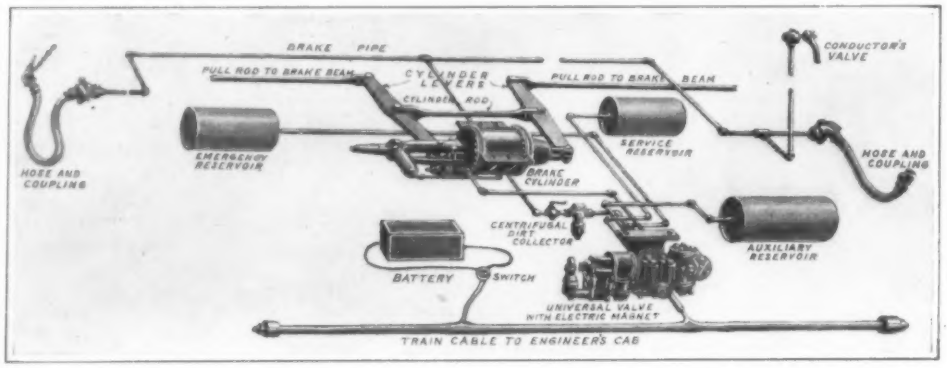
By Herbert T. Wade

THE Pennsylvania Railroad has adopted as standard equipment for all its new passenger trains the Westinghouse electrically controlled air brake, and the cars now in service are being supplied with it as fast as circumstances and funds available for such betterment allow. This important step is being undertaken only after an elaborate series of tests under actual service conditions carried on for several months with a complete train of twelve passenger cars and a modern steam locomotive. These tests demonstrated conclusively that with the new equipment it was possible to secure much quicker and more effective stopping, both in case of emergency and under ordinary conditions, as slowing down for a station or reducing speed on a down-grade with a corresponding increase of safety and economy in handling traffic. Not only were the advantages of the new arrangement demonstrated, but there was accumulated a mass of data dealing with the general questions of the theory and use of air brakes, derived from systematic study, in which the train equipped with special measuring and recording instruments of high precision, was virtually a scientific laboratory for the engineers and other experts of the Westinghouse Air Brake Company and the Pennsylvania Railroad.

Though various trials of improvements in air brakes and air brake equipment have taken place from time to time, not since the Galton-Westinghouse tests in England in 1878 had such extensive and scientific brake investigation been made. When it is stated that the number of these brake tests aggregated 691, and that they extended from February 10th to the end of May, 1913, their extent and character may be appreciated, as well as the amount of data accumulated for subsequent consideration in connection with almost every phase of the air brake problem. These results were then discussed by the engineers of the railroad and in their recommendation the decision to install the improved equipment was made, and this work is now in progress.

That improved air brake equipment is desirable in the interest of safety and more efficient operation is evident by a consideration of the change in conditions attending the development of the air brake. In the year 1890, with a train weight of 280 tons running at a speed of 60 miles per hour, the energy to be dissipated was about 33,000 foot-tons and the stopping distance with the application of the brakes was 1,000 feet. In the year 1913, with a train weight of 920 tons, running at this speed of 60 miles per hour, the energy dissipated was 111,000 foot-tons, almost four times greater than that of the train first mentioned. Now, if the second train was equipped with a brake of the same class as that of the former, the stopping distance would be 1,760 feet and its collision energy when it passed the 1,000-foot mark where the first train would have stopped would still be 48,000 foot-tons, or one and one half times as much as the 1890 train had when the brake was applied, with still 760 feet to run. With the latest improvement in the air brake such a train can now be equipped with the new brake apparatus so that it can be stopped in 880 feet, at which point with the old brake it would have been running at 43 miles per hour and with a collision energy of 57,000 foot-tons, or still about twice that contained in the train of 1890 at the beginning of the stop. In fact, the energy that must be dissipated by the air brake on a modern train with modern speeds of travel has increased eighty-fold since the original invention of the air brake. Looking at the matter in another way the problem may be stated as follows: To bring the speed of a train of twelve cars up to 80 miles an hour a distance of from 8 to 12 miles is required for such an acceleration, and the production of an amount of energy which must be dissipated in a few seconds in order to stop the train within a distance of approximately 2,000 feet.

The important advantages that now figure in the Pennsylvania equipment were secured by improvements both in the effectiveness of the brake as a whole, as well as in detail. By the brake is meant not only the triple valve fundamental to the Westinghouse air brake, but the entire mechanical organization and assembly of the various elements. Improvements were made in the efficiency of the braking system as a whole, and also in the automatic and manual control of the brake operated, this function, naturally, being rendered more difficult by the increasing lengths of trains. But before any such innovation could be made on a large scale it was necessary that it should receive a complete and thorough test under actual working conditions. This was done on the Pennsylvania Railroad, employing a train of twelve steel passenger cars and a modern locomotive, weighing nearly 1,000 tons and about 1,000 feet in length, on a special section of track on the West Jersey and Seashore division of the Pennsylvania system, near Absecon. The locomotive and cars are fitted with the new mechanism, which, in its most improved form, aside from the principle of operation concerned, involved also the use of two shoes per wheel as higher retarding forces could be developed than were possible with a shoe on only one side of the wheel, on account of the limits of excessive piston travel, of brake shoe wear and distortion producing variable results of unequalized strains in brake, and of journal troubles.



Schematic representation of electro-pneumatic air brake installed on a passenger car.

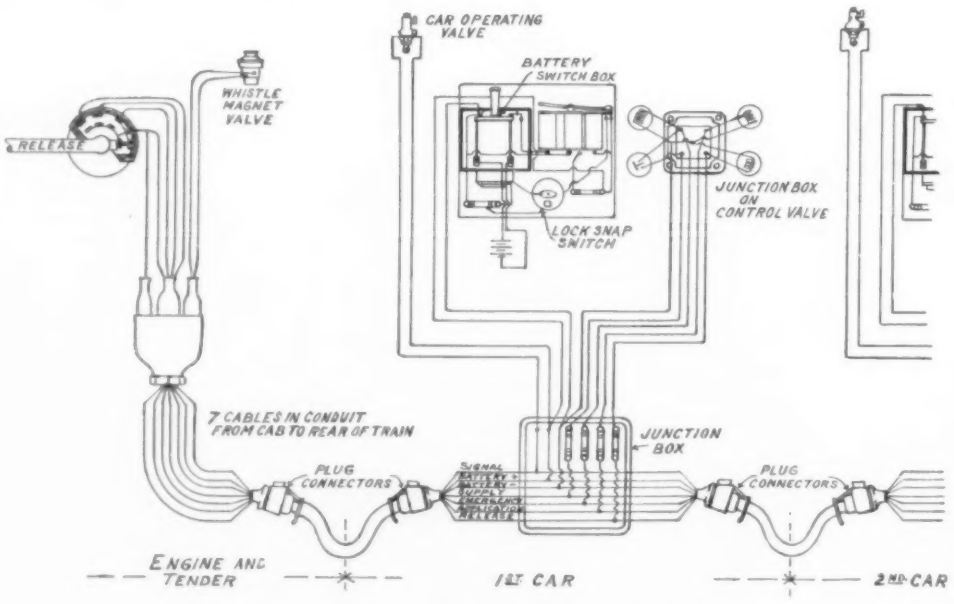


Diagram of wiring and connections for electric control of air brake.

In the improvement and perfection of the air brake many elements successively have been added until to-day the mechanism, while increasingly effective, is of considerable complexity. For example, with long trains with the older systems there would be delay in the application of brakes at the rear, and there would be unevenness and shock in stopping. Due to the delay incident in the mechanical operation of the system the stopping distance at high speeds and with heavy loads and long trains could not hitherto be reduced as was desired in the interest of safe and effective operation. The new system secures immediate action at each triple valve by substituting therefor a universal control valve, where not only are all the essential features of the air control included, but also there is incorporated an electric system whereby the braking mechanism at the rear end of a long train, or at any car, in fact, does not have to wait an appreciable amount of time for the difference in pressure to be realized, but the valves are opened or closed by local electro-magnets energized from a battery circuit in each car.

The electro-pneumatic equipment is arranged so that when operated electrically the service application of the brakes is actuated by a reduction in brake pipe pressure as when operated pneumatically. The electric effect is the same as the pneumatic effect and the electric valves operate the pneumatic valves in similar fashion, only the response is made immediately—the electro-magnetic valves responding more promptly. The release magnets are controlled by the brake valve handle in either release or holding position, and with an electro-pneumatic emergency application the emergency magnets on all cars simultaneously and instantaneously energize and open their respective emergency magnet valves, which, in turn, cause the quick action parts of each universal valve to operate and produce an emergency application of the brakes. If the hose bursts or a conductor's valve, familiarly seen in a passenger car, is opened, the first universal valve to be affected by the resulting drop in brake pipe pressure will operate pneumatically and close its emergency switch so that the emergency magnet circuit throughout the train is energized and an electric emergency application on all brakes obtained.

The new system, which at first examination is quite complicated, both by its arrangement of electric connections and the arrangement of valves and magnets, secures now the application of the air brakes more quickly, also giving increased emergency stopping power, and enables the use of a higher pressure which may be held without diminution toward the end of a stop, while at the same time a more efficient design and better installation of foundation brake rigging has been adopted so that both the application and release of the brakes is more positive and reliable in all its operations. The new system, as stated, employs two shoes per wheel which is known as the "clasp brake," and it is arranged to operate so that the time of obtaining the maximum emergency brake cylinder pressure on the train as a whole, according to the official tests, was shortened from eight seconds with the best previous equipment to 3.3 seconds with the improved apparatus; and when the electric control, which was a further feature of the new system, was used, this could be diminished to 2.25 seconds. The electric system is controlled from the engineer's valve without extra levers or switches, the electrical mechanism being connected with the simple control valve, the circuits being arranged within. The system also works automatically in case of any failure along the line, and there results a simultaneous application of just as great retarding forces with the elimination of all violent slack action and shock.

With the universal control a train of twelve steel cars and locomotive with the electro-pneumatic brake, 150 per cent braking power, clasp brake rigging, unflanged brake shoes, can be stopped:

From 30 miles per hour in 200 feet equivalent to an average retarding force of 300 pounds per ton.

From 60 miles per hour in 1,000 feet equivalent to an average retarding force of 240 pounds per ton.

From 80 miles per hour in 2,000 feet equivalent to an average retarding force of 214 pounds per ton.

It would seem, therefore, that here we have an important step forward toward increase of safety and that increased speeds may be used with proper safety, while greater density of traffic can be permitted under good conditions of operating that will give increased returns.

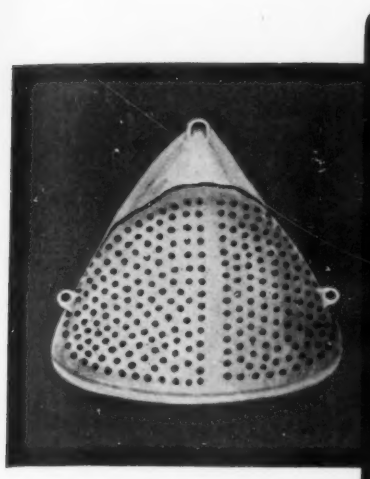


Fig. 1.—Respirator capable of being used with absorbing chemicals.

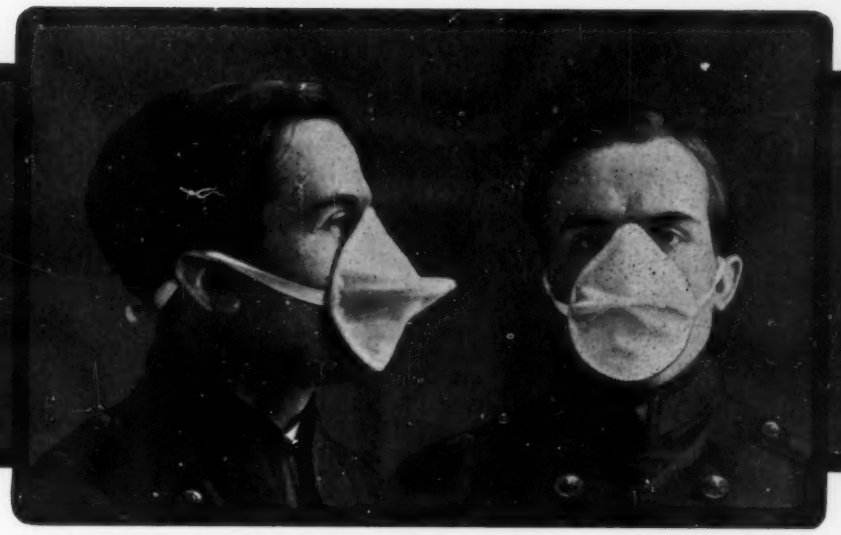


Fig. 2.—Two views of a French type of flannel muzzle.

Fig. 3.—Italian respirator provided with exit valve for exhaled air.

The Use of Poisonous Gases in Warfare

How Gases Are Generated and How Men May Protect Themselves From Them

By John B. C. Kershaw, F. I. C.

THE earliest use of deleterious gases in siege warfare is recorded in the history of the Peloponnesian wars from 431 to 404 B. C. During this struggle between the Athenians and Spartans and their respective allies, the cities of Platea and Delium were besieged. Wood saturated with pitch and sulphur was set on fire and burnt under the walls of these cities, in order to generate choking and poisonous fumes, which would stupify the defenders and render the task of the attacking forces less difficult. Another form of the same method of attack used about this date was to fill a cauldron with molten pitch, sulphur, and burning charcoal, and to blow the fumes with the aid of a primitive form of bellows and air-blast, over the defenders' lines.

Greek-fire, about which much was heard in the wars of the middle ages, was a liquid, the composition of which is now unknown, that was squirted through the air, and was used for setting fire to the buildings or places attacked. It was employed chiefly in sea-fights in order to set fire to the ships of the enemy, and it was used by the Byzantine Greeks at the sieges of Constantinople in the years 1261 and 1412.

Turning now to the application by the Germans of poisonous gases to trench warfare, we have the following official descriptions of the character and appearance of the gases, and of their effects:

Sir John French, in his report, dated May 3rd, asserts that "the gases employed have been ejected from pipes laid in the trenches, and also produced by the explosion of shells especially manufactured for the purpose. The German troops, who attacked under cover of these gases were provided with specially designed respirators, which were issued in sealed pattern covers. This all points to long and methodical preparation on a large scale.

"The effect of this poison is not merely disabling or even painlessly fatal, as suggested in the German press. Those of its victims who do not succumb on the field, and who can be brought into the hospital suffer acutely, and in a large proportion of cases die a painful and lingering death.

"Those who survive are in little better case, as the injury to their lungs appears to be of a permanent character, and reduces them to a condition which points to their being invalids for life. These effects must be well-known to the German scientists who devised this new weapon, and to the military authorities who have sanctioned its use."

The following description, given by a British officer and published in the daily papers, shows the effects of the poison gases upon the men who survived them, and were carried into the hospital:

"When we got to the hospital we had no difficulty in finding out in which ward the men were, as the noise of the poor devils trying to get breath was sufficient to direct us. We were met by a doctor belonging to our division, who took us into the ward. There were about twenty of the worst cases in the ward on mattresses, all more or less in a sitting position propped up against the walls. Their faces, arms, and hands were of a shiny grey-black color, with mouths open and lead-glazed eyes, all swaying slightly backward and forward trying to get their breath. It was the most appalling sight, all these poor black faces struggling, struggling for life."

Dr. J. S. Haldane, F.R.S., who was sent out to France to investigate the effects of these gases, and to report upon the best methods of protection, states that:

"The symptoms and the other facts, so far ascertained, point to the use by the German troops of chlorine or bromine for purposes of asphyxiation. There are also facts pointing to the use in German shells of other irritant substances, though in some cases at least, these agents are not of the same brutally barbarous character as the gas used in the attack on the Canadians. The effects are not those of any of the ordinary products of combustion of explosives. On this point the symptoms described left not the slightest doubt in my mind."

A deposition by Capt. Bertram of the Eighth Canadian Battalion states that: "On Thursday, April 22nd, he was in a support trench, about 600 yards from the German lines, when he saw first of all, a white smoke rising from the German trenches to a height of about 3 feet. Then in front of the white smoke appeared a greenish cloud, which drifted along the ground to our trenches, not rising more than about 7 feet from the ground, when it reached our first trenches. Men in these trenches were obliged to leave, and a number of them were killed by the effects of the gas."

British soldiers prepared to weather a gas attack.

The last description indicates that the gases used in this attack were a mixture of sulphurous acid and chlorine. The former is a dense white gas and the latter is green—both gases are heavier than air and would therefore, creep along the ground—and they can be generated cheaply, in large quantities in the trenches, by comparatively simple means. Both gases are asphyxiating when breathed even in a dilute state—and when inhaled without much air dilution they would produce the effects upon the lungs that have been already described. As regards the methods of generating these gases, the sulphurous acid gas was probably made in the trenches by the simple expedient of throwing sulphur into open braziers containing charcoal or coke fires, while the chlorine was very probably brought to the trenches compressed under 5 atmospheres (or 76 pounds) into liquid form, in large steel cylinders similar to those used for compressed oxygen and hydrogen gases. The electrolytic method of decomposing common salt and producing caustic alkali is widely developed in Germany, and the chlorine liberated by this process has been, in the past, somewhat of a drug on the German chemical market. Quite possibly large stocks of chlorine gas in liquid form have been accumulated in Germany in recent years in view of this war, but the German military authorities in any case will have ample reserves of their latest form of ammunition ready to their hand, in the salt deposits of Stassfurt and elsewhere. Having brought a sufficient number of the cylinders of compressed chlorine to the trenches, it is merely necessary to insert a delivery pipe through the outer wall or parapet of the trench, to connect this to the cylinder, and then to wait for a favoring wind before turning on the gas tap, and allowing the gas to escape from the cylinder under its own pressure.

Since the liquefaction pressure of chlorine is so low, a very large number of gas cylinders would be required to transport a large volume of gas to the trenches where it was to be employed, but this would not prove an insuperable obstacle to an army well provided with motor transport.

Considering now the means of defence against sulphurous acid and chlorine gas, one must note first that neither gas is poisonous in the sense that carbon monoxide gas is poisonous, that is neither gas forms a poisonous compound with the corpuscles of the blood. The gases are poisonous in the sense that they produce death by asphyxiation or by producing irritation and inflammation of the bronchial tubes and lung tissues, and if these gases are well diluted with air before they are inhaled, their permanent poisonous effect is greatly reduced.

Turning now to the practical question of the means of defence against poisonous gases, these may be divided into two broad classes, according as they depend upon chemical or mechanical principles of removing the gases from the air.

The first form of respirator, supplied to the British troops in Flanders, belonged to the former class, and was based upon a pattern supplied by the Admiralty. Over a million of these respirators (made by voluntary labor), consisting of a covering for the mouth and nose of stockinette lined with cotton-wool, were sent out toward the end of April. These respirators, however, have not proved efficacious in warding off the evil effects of the gases when these latter have reached the trenches in a fairly condensed form, and Dr. Haldane has been sent out again to Flanders to experiment with various forms of larger respirators and head coverings of helmet shape, in which cotton wool or cotton waste

(Concluded on page 598.)

A Study in Instinct

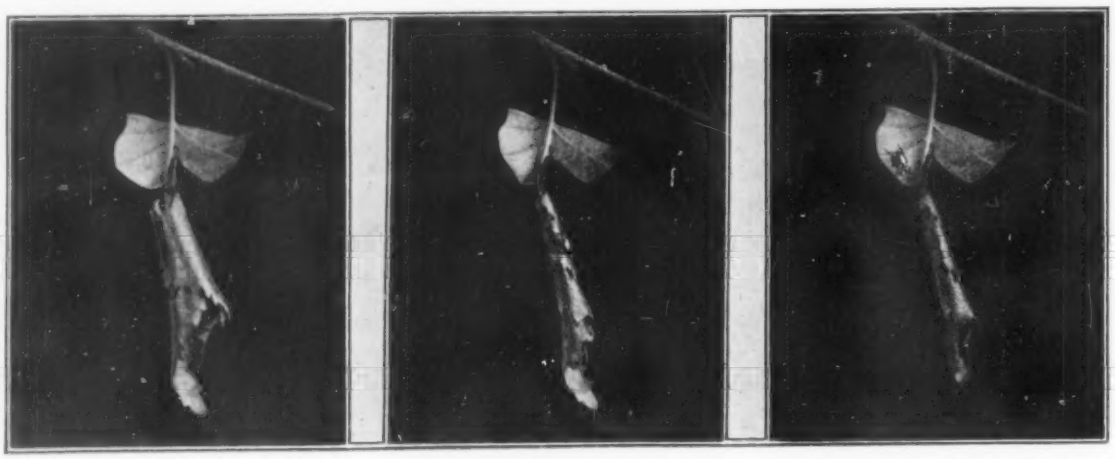
The Leaf Roller and Its Writhings

By Harold Bastin

WHAT is instinct? We do not know. Yet we frequently make use of the word, usually to express our recognition of the fact that many animals are governed in their behavior by inward promptings which are not the outcome of intelligence. An animal follows a course of instinctive action because it must—not because it has deliberately chosen that course with the object of attaining some definite end. This point calls for strong and frequent emphasis by serious students of psychology, since many popular writers on natural history falsely endow their beasts and birds with a complete set of human faculties and emotions, thus mystifying the general public. Naturally, it is not always easy in a given case to determine exactly where instinct ends and intelligence begins; but our difficulties in this respect can only be increased by a careless use of terms and a misrepresentation of ascertained fact.

The easiest way to grasp the significance of the word *instinct*, as employed in the scientific sense, is to examine critically an actual case in point. Cases of pure instinct occur most commonly among insects; and for our present purpose we may consider briefly the activities of certain small weevils which are grouped by naturalists in the families *Rhynchitidæ* and *Attelabidæ*. These insects are known popularly as "leaf-rollers," because the females, at the period of egg-laying, prepare leaves in an elaborate manner to serve as food and dwelling-places for their young. Both families are represented in the American continent; but in Europe the species are much more numerous, and one (*Rhynchites bacchus*) ranks as a "pest," because it sometimes mutilates vine leaves in such numbers as seriously to hamper the growth of the plants.

These weevils cut and roll their leaves in characteristic ways, according to the species, and frequent different kinds of plants. The subject of this article (*Rhynchites betulæ*) occurs most commonly on the birch. Let us suppose that we have before us one of these insects, and that she is about to commence work upon a leaf. In the first place she does much prospecting, moving deliberately about, both upon the upper and under surfaces of the leaf. If satisfied with her investigations, she at length makes her way to a point at the edge of the leaf, not far from the stalk, and standing upon the upper surface, cuts the substance with her jaws in a long curve from the edge to the midrib. She then ascends the leaf for a short distance, and from the other side of the midrib makes another curving cut to the opposite edge.



Final successive stages of the leaf rolling, consisting of tightening and closing the leaf. In the second view the weevil is engaged in fixing down the overlap, and in the last view she has tucked in the leaf tip, and is about to partially sever the midrib, as described in the text.

In favorable circumstances, the two cuts are made in from ten to fifteen minutes. Then comes a lengthy pause, presumably that the leaf may wilt and thus become sufficiently flexible for the work that is to follow. It is important to realize that the cuts made by the beetle are conducted on highly satisfactory mathematical principles, being exactly such as are needed to render the subsequent rolling of the leaf most easy to accomplish. Should the insect fail to project her curves with accuracy, she would fail also to roll up the leaf.

When the leaf has become sufficiently pliable the weevil goes to its under surface, and standing close to the edge where her original cut begins, commences to roll the severed portion round an ideal axis by means of her legs. Having reached the midrib, she alters her tactics somewhat, now drawing the second half of the leaf round the first, with the result that she herself is soon inclosed in the folds. At about this stage she makes several incisions in the leaf substance and lays an egg in each. Thereafter she comes forth, tightens the roll, and fastens the overlap with her jaws. Then she makes a small, separate roll of the leaf tip, and bends it inward so as to close the end of the main roll. Then, finally, she ascends the leaf, and partly cuts through the midrib at the point where her first curve meets it. This she appears to do in order to promote the particular state of decay in the leaf which will render it fit food for the grubs. The above is the briefest possible description of what this insect does—not once, but many times in the course of her adult life. If we examine her work in detail, take measurements, and consider the well-ordered sequence of her various actions, our first impulse is to exclaim: What amazing cleverness and skill! Yet when we trace the life-cycle of the insect, we are forced to admit that such praise is unmerited. The eggs, which hatch in the rolled-up leaf, produce blind and legless maggots. These feed upon the decaying leaf tissue around them, and when full grown allow

(Concluded on page 598.)

Specimens of leaves in process of being rolled by small insects.
One purpose of this proceeding is to procure a dwelling place.

The central figure is the leaf-rolling weevil (*R. betulæ*), much magnified. In the lower illustrations, that at the left shows the leaf-rolling weevil on the upper side of a birch leaf, which she has just finished cutting. The other three views show successive stages in the work of rolling the leaf. It will be observed that she works from the under side of the leaf. The eggs are laid when the last stage here shown is reached.

A study in instinct.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

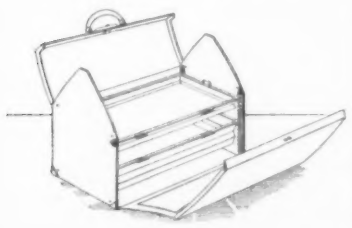
RESILIENT CONNECTING DEVICE.—J. P. WILSON, 800 W. 8th St., Los Angeles, Cal. Resilient means provide for connecting two members or articles, such as for attaching suspender parts to trousers, or for use in or with garment supports, or trusses, or other articles of wear involving the yielding connection of two articles or members, or the attaching of one article to another, whereby the connecting means will be under tension.

SHOE HEEL.—L. F. HERING, General Delivery, Pomona, Cal. The inventor provides a cushion heel, including a pair of telescoping members having a coil spring interposed between them, one of the members being adapted to engage the ground in walking and telescope within the other against the action of the spring, said members being so formed as to prevent displacement one from the other.

HAT PATTERN.—LYDIA K. WHEELOCK, 47 Clearemont Ave., New York, N. Y. This invention refers to hat patterns for hat structures for ladies' wear, and more particularly to hats made in various designs for such patterns, and the invention further comprehends an improved pattern and method of designing the same as well as generally an improved system of constructing hats for such patterns.

BATHING CAP.—ELSIE HILLER, 114 W. 32nd St., New York, N. Y. The invention provides a cap having ornaments attached thereto; provides a cap with ornaments impervious to water; provides a cap constructed from elastic material adapted to conform to the shape of the head of the wearer; and provides a decorated cap, the ornaments whereof are held in position by being adhered to the structure without perforating the same.

DRESSER VALISE.—G. COHN, 122 W. Bunett St., Louisville, Ky. The invention relates to improvements in valises and more particularly to one designed more especially for use while traveling and where it is desired to have



DRESSER VALISE.

a sufficient quantity of clothing and accessories conveniently and compactly arranged to render the same readily accessible and without the usual inconvenience experienced in the use of the ordinary style of valise or handbag.

MEANS FOR ATTACHING COLLARS AND OTHER NECKWEAR TO SHIRTS.—B. JOACHIM and B. DAVIDSON. Address the former, 66 Arsdale Terrace, E. Orange, N. J. This invention constitutes a tangible element carried by the neck band of a shirt and an intangible element carried by the collar or neckwear for convenient attachment and removal of the collar at the back of the neck band, thus providing space for the free sliding of the tie, as well as avoiding the use of buttons.

BATHING CAP.—H. P. RINDSKOPH, 397 Sumner Ave., Brooklyn, N. Y. This invention provides a cap which may be placed in wearing position and removed therefrom without disarranging the hair; provides a retaining device for a cap which may be installed without injuring the arrangement of the hair; and reduces the cost and simplifies the construction of the cap.

Pertaining to Aviation.

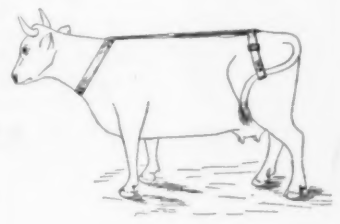
PROJECTILE FOR DESTROYING AIRSHIPS, BALLOONS, AND OTHER AEROSTATS.—R. A. FEATHERSTONE-SMITH and M. B. COOPER. Address Day, Davies and Hunt, 321 High Holborn, London, W.C., England. The invention is characterized by constructing the projectile with one or more passages for gas from the airship gas bag and outside air to pass along to form an explosive mixture in the bag or inner outer envelopes of the airship and in the projectile, by adapting the projectile for automatically igniting the explosive mixture to destroy the airship, by providing the projectile with means for forcing a blast of air into the gas bag of the airship to hasten the production of the explosive mixture, and by adapting the projectile with means for limiting its penetrations into the gas bag of the airship.

Of Interest to Farmers.

EGG CONTAINER.—W. H. LEWIS, L. B. 28, Arrington, Va. Objects of the improvement are to provide a container having cells adapted to conveniently receive separately wrapped eggs; and to provide cells in which eggs will be fully protected against breakage by the ordinary shocks or pressure to which they are subjected in transit, particularly in shipping by parcel post.

COTTON HULLER.—J. C. CONRAD, Cement, Okla. An object of this invention is to provide a device by means of which the cotton may be thoroughly cleaned of the hulls, the former being passed from the machine, and the latter also being conveyed away from the interior of the machine.

COW'S TAIL HOLDER.—E. QUICK, Trinidad, Colo. The main object of the invention is to so secure the tail of a cow that the animal may not switch its tail in an effort to rid itself of insects, such as flies, mosquitos, gnats, etc. It is well known that cows switch their tails continually, either to brush off insects, or from

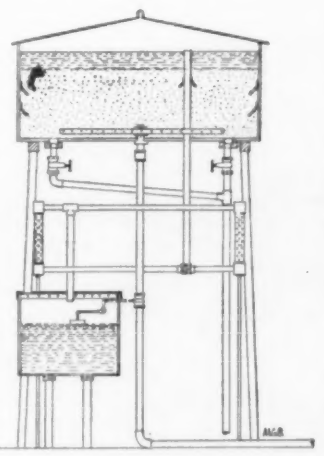


COW'S TAIL HOLDER.

a nervous habit, and this tends to brush foreign matter, such as dirt, dust, and the like into the pail during milking, particularly when the tail is filled with the filth of the yard or pasture. The invention prevents such milk contamination.

Of General Interest.

A FILTERING APPARATUS.—DR. A. H. BALDWIN, Norwalk, Conn. The accompanying drawing shows a filter of very inexpensive construction and one that can be maintained at little cost. It is adapted to be located in the city instead of at the source of supply. It consists of an iron reservoir about twelve feet deep and filled with sand to about two feet from the top. Water is turned in at the bottom under city pressure and forces its way up through the sand until it overflows a standpipe. Thence it is led through several eight-foot tanks filled with animal charcoal, and



FILTERING APPARATUS.

passes through an aerator located above a second reservoir. When this reservoir is filled the supply to the filter is automatically turned off by a float. The filter does not need to be cleaned until about eight of the ten feet of sand has become vitiated from the bottom up. Experience has shown that most of the organic matter is oxidized in the sand, so that 10 per cent of the quantity that would accumulate on the surface of an ordinary filter is to be found in this filter. With this system only the water for drinking purposes is filtered. That which is used for watering the lawns, for instance, is not robbed of its fertilizing material. See advertisement on page 598 of this issue.

PRODUCTION OF WET CARBONIZED PEAT BRIQUETS.—N. TENTRUP, 6 Broad St. Place London, E.C., England, and T. RIGBY, Station Hotel, Dumfries, Scotland. The invention relates to the production of peat which has been heated to a temperature between 150 degrees and 250 deg. Cent. under pressure as proposed by Ekenberg. The process allows of effecting a material saving in the cost of producing briquets from such material relatively to the cost of production according to processes previously proposed therefor.

EDUCATIONAL CHART.—C. E. BIRCH, care of Haskell Institute, Lawrence, Kan. This invention relates to charts adapted for use in the teaching of arithmetic to children, and one of the main objects thereof is to provide a device of such form as to facilitate certain fundamental drills and to make them interesting and effective and, also, by making them competitive.

POLISHING MITT.—H. W. HEPNER, care of Muhlenberg College, Allentown, Pa. The invention provides an article with a tubular brush, affording a number of surfaces, adapted for special employment; provides a wallet-like container for said brush, foldable to facilitate personal carriage or the packing within a satchel or trunk; and provides a device having means for carrying a toilet equipment.

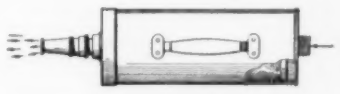
PARCEL POST PROTECTOR FOR MAIL SACKS.—HANNAH HAZELTON, 377 Quincy St., Brooklyn, N. Y. The invention has reference more particularly to a protector designed to fit in a mail sack in order to reinforce the latter for the purpose of preventing injury to articles placed in the sack during the handling and shipment, and more especially as applied to parcel post transmission.

FASTENER FOR BOX COVERS.—F. D. VAN VALKENBURGH, Delachise St., New Orleans, La. The present invention has reference to a novel fastener for box covers, and is designed more particularly for use in connection with shipping cases having reversible covers, and intended to be returned to the shipper. The invention is applicable to any improved form of case.

WATCH CASE AND MOVEMENT PROTECTOR.—E. A. RONEY, Goldfield, Nev. One of the principal objects of the invention is to provide a pouch or a shield formed of insulated material and adapted to receive a watch whereby to prevent the conduction of electrical current through the watch and to protect the watch from dust and dirt.

SANITARY SODA CUP.—D. F. CURTIN, Address The Vortex Mfg. Co., Goetz Bld'g., 412-420 Orleans St., Chicago, Ill. This invention provides a cup for use in dispensing beverages, as, for instance, in soda fountains and like places, wherein a holder is provided for permanent use and a particular form of cup for use with the holder, each cup being designed to be discarded after one using.

SPRAYER.—NELLIE M. MCCAULEY, Kalispell, Mont. The improvement refers to sprayers and more particularly to a device for spraying insecticides or other liquids. A spray is provided which utilizes the water pressure in



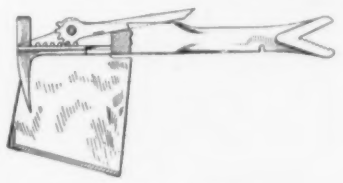
SPRAYER.

an ordinary garden hose or one of a similar nature, in spraying the liquid without resulting in the mixture of the water with the liquid. The accompanying engraving shows an elevated view of the sprayer partly in section.

Hardware and Tools.

DOOR LATCH.—F. E. RICHARDSON, Manchester, Iowa. This invention relates to means for holding doors in closed position, particularly sliding doors such as are used on barns and the like. The latch is used as a lock for the door in conjunction with a wire yoke and a pad-lock, and may be operated from the outside or from the inside of the door in its normal use.

COMPOUND TOOL.—S. E. DENT, Little Rock, Ark. This invention relates to compound tools and the object thereof is to provide a tool embodying various implements in connection with the setting up and repair of wire



COMPOUND TOOL.

fences, the inventor's object in particular being to provide an implement of this character, including novel and improved means for withdrawing fence wire staples in such a manner as to permit of their subsequent use.

Heating and Lighting.

KILN.—S. P. BEEBOUT. Address W. B. Gray, 1327 S. 22nd St., Louisville, Ky. The inventor provides a kiln of the circular stationary type, for use in burning sewer pipes, tiles, conduits and other products from shale and clay, wherein a novel arrangement of flues, passages and supporting floors is provided, so arranged as to obtain a uniform heat effect on the ware, throughout the interior of the kiln, to insure uniform burning of the ware.

Household Utilities.

FAN ATTACHMENT FOR ROCKING CHAIRS.—W. L. KLINE, Feronia Way, Rutherford, N. J. The invention provides a fan attachment for rocking chairs, cradles and similar articles of furniture, and is arranged to produce a continuous current of air directed onto the occupant as long as the rocking chair or similar article is rocked.

JAR COVER.—ISABELL BELL, 221 St. Anthony Ave., St. Paul, Minn. This invention relates to a temporary cover, attachable to jars and like vessels, such as butter and preserve jars, jelly glasses and the like, whereby to protect the contents of the jar from dust and flies. The cover has provision for adjusting its size to suit jars of varying diameter, within the capacity of the cover.

Machines and Mechanical Devices.

STRAW HOLDER.—E. O'CONNOR, 2945 Cedar St., Everett, Wash. The particular object here is to provide a machine in which a supply of drinking straws may be held and mechanically dispensed one at a time in order to prevent contamination of many straws upon the removal of a single straw in the holders at present employed for this purpose.

TRIMMING MACHINE FOR ROLLS.—M. F. ANDERSON, care of Standard Oil Cloth Co., 320 Broadway, New York, N. Y. The inventor provides a new and improved machine for simultaneously trimming both ends of a roll of oil cloth or other material, and arranged to permit convenient adjustment of the knives or cutters for trimming rolls of different length.

Prime Movers and Their Accessories.

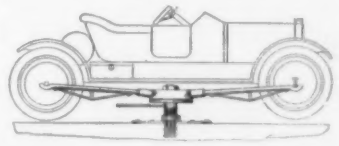
PACKING.—G. MCCADDEN, St. Cloud, Minn. In the present patent the inventor's object is the provision of a new and improved packing for use on pistons and other devices and arranged to prevent leakage of the motive agent past the packing from one end of the cylinder to the other end thereof.

Pertaining to Recreation.

BILLIARD CUE TIP FASTENER.—L. CIARLELLI, 146 Bradford St., Bristol, R. I. In the present patent the invention has reference to a novel means for fastening the tip to cues, the object being the provision of means for the secure holding of the tip, while permitting of its ready removal and renewal whenever desired.

Pertaining to Vehicles.

AUTOMOBILE JACK.—I. W. FURMAN, Bay Shore, N. Y. This invention provides means for lifting a vehicle of the character indicated in one operation; provides means for rotating the vehicle about a self-contained center; and provides a rotary supporting apparatus adapted



AUTOMOBILE JACK.

for removal from its service position. The engraving herewith gives a side view of the jack, and showing in conjunction therewith an automobile, the same being supported in lifted position thereon.

ASH CART.—H. MECKING, 1044 Hall Place, Bronx, New York, N. Y. The invention has reference more particularly to a cart arranged with a closed top, which top is provided with an ash-barrel inlet supplied with a hood, and means at the inlet to facilitate the discharge of the ashes from the barrel and to prevent the falling of the barrel into the cart.

VARIABLE SPEED GEARING FOR MOTOR CYCLES.—E. A. BLACK, Phoenix, B. C., Canada. The invention has special reference to motor cycles having but one speed and usually termed single speed machines, by which the operator has all the advantages of the high or usual gearing on level roads and of low gearing on hills or bad roads. The drive parts and controlling means obtain the high and low speeds or permit the engine to run free while the motor cycle is at a state of rest.

Designs.

DESIGN FOR A PLATE OR SIMILAR ARTICLE.—LE ROY C. LEWIS, care of Koehler & Hinrichs Co., St. Paul, Minn. In this ornamental design the plate is of circular form and bearing on its outer edge a wreath within which are two animals sitting upright and clasping their fore paws.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

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Picture Shows the 1916 HUDSON—Out Now

More Reasons for 1916 Hudson

To all the HUDSON attractions we now add these:

Yacht-Line Body
Ever-Lustre Finish
A Roomier Tonneau
More Luxury
A $1350 Price

That price means another $200 reduction, the second in twenty months. Both have resulted from multiplied output, due to the car's popularity. Now at $1350 we are swinging open in the widest way the gates to HUDSON class.

Some Other Things You've Wanted

We do not, and we cannot, offer you a better chassis. Nobody wants or expects it. Howard E. Coffin did his best in designing this. Our engineering corps has done its best in refining it. This final Six embodies all that seems to us desirable.

In twenty months, 15,000 men have bought this new-type HUDSON. They've applied every possible test. And not one, we believe, has ever seen, or wants to see, a better car than this.

But there are things you do want, which all cars lacked, and we've brought them out this year.

Yacht-Line Body

This is the fruition of all aims since foredoors were inserted. Then came straight lines, then streamlines, but all those lines were broken. In this Yacht-Line Body we reach perfection in graceful, sweeping lines. Even the door lines are unbroken. The body and door tops form a level line, and that line is *leather-bound*.

We have widened the rear seat so three big folks don't crowd it.

We have built a roomier tonneau. And the room is doubled when only five are riding. The two extra seats completely disappear.

We upholster with enameled leather this year, the costly finish of the high-priced car. Thus we bring you all the comfort, all the luxury possible to give.

For safety's sake, and for extra wear, all wheels have non-skid tires.

Finish That Stays New

And now we bring out a much-wanted innovation — our Ever-Lustre finish, exclusive to HUDSON cars. It has required an immense factory addition, equipped with ovens to hold hundreds of bodies.

Now each under-coat of finish goes on under pressure, is forced into every pore. Then each is baked on to give it wondrous hardness. The result is a finish which keeps its newness and lustre. It resists weather and washing, rubbing and mud. It combats as never before the main cause of depreciation.

A Trebled Output

But our best announcement is a trebled output. There will be overdemand for a while now, as with every new-model HUDSON. But the long waits of last year will not be repeated. And men who want HUDSONS will not be forced to take some second choice.

We are building of this new model 100 cars daily—a record fine-car output. You can get one — perhaps at once—if you see your dealer now. These new cars are now everywhere on show.

7-Passenger Phaeton or 3-Passenger Roadster, $1350, f. o. b. Detroit
Also a new Cabriolet, $1650, f. o. b. Detroit

Each HUDSON car brings with it the matchless HUDSON service. Ask our dealer to explain it. You will see how much it means.

HUDSON MOTOR CAR COMPANY, Detroit, Michigan